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SUNFLOWERS.

BY GRANT ALLEN.

IT is well to choose a text which everybody can easily verify for himself; and as hardly a house is now without a sunflower, I may as well choose that fashionable blossom as the subject for this morning's discourse. Take down one from the drawing-room mantel-shelf, and you will be able to follow for yourselves what I have to say to you. You had better choose a blossom in which the central florets have not yet begun to open, as you will then be able to find flowers in every stage of development.

The sunflower, I need hardly say, is a member of the composite family; and each head is not, of course, a single separate flower, but a whole collection of hundreds of golden bells. If you pull out one of these, you will find it consists of a yellow tubular flower, five-lobed above, and bulging broadly at its base. This flower surmounts a large seed, or rather fruit, with one or two wings at its top, which are all that now remain of the original calyx.

In the centre of the compound flower-head you will find a mass of unopened flower-buds, each one covered and protected by its own scaly bract. These bracts are the remnants of the little leaves which once grew under each blossom when the ancestors of the sunflower still possessed long spikes of flowers. But in course of time the composites learnt to flatten out their spike into a broad, disc-like head. Still, however, the bracts, in a much-dwarfed form, remained to separate the individual little bells; and in some cases, as in the sunflower, they have been utilised for a new purpose—namely, to protect the unopened flower-buds from insects which might otherwise eat them, or lay their eggs upon them. Many composites still retain the bracts; in others, and often in closely allied forms, they are wanting, having been gradually lost by disuse. There are none in the daisy or the dandelion.

Beyond this central region, where the buds are yet unopened, you will find two or three rows of newly-opened flowers, with all their lobes displayed, and with the little black stamens standing up conspicuously in their midst. These florets are in their first or male stage. If you open carefully with a needle the tube formed by the united stamens, you will find inside the little style, with its two branches still pressed closely together. The bee hovering over these florets in the first state, dusts himself over with pollen from the yellow tips of the anthers. This he afterwards carries away to fertilise the other florets.

Outside the rows of flowers in the first male state we come to some other and more crowded rows, which have reached the second or female condition. In them the style has grown longer, so as to overtop the now withered stamens. At the same time, its branches have opened outward, and now curl over gracefully, so as to expose their sensitive surfaces. If you look closely you can see, even with the naked eye, grains of pollen clinging to their surface.

Outside these female florets again come a few rows of fully-fertilised and over-blown blossoms, which are crowded together by pressure from within, and of which the bees and other visitors hardly take the slightest notice.

Lastly of all, on the very outside of the great compound flower-head, we reach the big expanded golden ray florets, which are, in fact, neuter members of this organised floral community. Their business is to make as large a display as possible, and so to attract insects to the fertile florets in the centre. If you pull out one of them carefully, you will find that it is tubular in its lower portion, but that the broad upper part is formed by the splitting open of the tube on the inner side. One may still observe faint traces of the original five lobes even in these very enlarged and distorted florets, especially at the tip, where they are often notched or divided. In some composites the expanded ray florets still keep their styles; but in the sunflower they have become wholly abortive. We may thus compare the compound head in some respects with a hive of bees containing females, males, and neuters.

It will be observed that the sunflower opens from without inward, and the bee who approaches it visits it in the same order. Thus he comes in contact first with the florets in the female stage on the outside, and dusts them over with pollen which he brought from the last head. He then proceeds to the inner rows of male florets, from which he unconsciously collects pollen to carry to some neighbouring plant. If either the sunflower or the bee reversed this proceeding, the result would be that the florets would get fertilised with pollen from their own brother flowers, the least desirable form of cross-fertilisation; but here, as elsewhere, natural selection has adapted the habits of the plant to those of its regular visitors, and has thus secured the best form of impregnation. Bees are particularly fond of the sunflower, and obtain from it large quantities both of pollen and honey.

The fruit of the sunflower has no feathery top or pappus to float it away like the dandelion and thistledown. It is too large and heavily stored with rich food-stuffs for the young plant to admit of that form of dispersion. So the calyx, instead of being transformed into a pappus, as in most other composites, here remains simple and cuplike. But the seed profits in the end by its richness in oil and other valuable stores, for the sunflower plant is thereby enabled to get that splendid start in life which makes it into one of the tallest and stoutest annuals of temperate climates. Very few species attain so immense a height in a single year. Probably, too, no other annual, except Indian corn, produces so large a number of so richly-stored seeds. It is this provision on the part of the mother-plant which allows them to reach so great a stature during a single short summer.

XUM

A STRANGE DISORDER.

A VERY curious disorder of the nervous system is described in the *Revue Scientifique* of August, being taken from the *Archives de Neurologie* for April of this year. It appears that, in the U.S. State of Maine there are some persons in apparent health except so far as relates to nervous excitability, which is excessive. The least irritation causes them to jump. They also feel compelled to execute anything they are ordered to do, and they repeat the command in a loud voice. Dr. Beard reports that one "jumper," as they are called, was sitting on a chair cutting tobacco. He went up to him, struck him suddenly on the shoulder, and said, "Throw it away!" He repeated the words in a voice of terror, and threw his knife, so that it stuck in a door opposite to him. Two other jumpers struck themselves violently on being told to do it.

This disorder appears to be hereditary. In one family Dr. Beard found the father, his son, and two little girls of four and seven affected by it; and in another case three brothers were its victims.

A similar complaint occurs in the Malay region of Asia, and it has been observed amongst various races, Tamils, Bengalese, Sikhs, and Nubians. The Malays call the patient a *latah*, a word of wide significance, applied to various degrees of nervous excitability. Mr. O'Brien states that when travelling in the Malay Peninsula he had as a servant a young Malay whom his comrades called a *latah*, though his conduct and conversation indicated nothing irrational. Four-and-twenty hours elapsed before his peculiarity was displayed. A signal fuse was then fired by way of rejoicing, and the doctor was about to ignite another when the young man pushed him violently on one side, seized the torch, lit the fuse, and fell to the ground face downwards, uttering a strange cry. The next day he seemed all right, but when the doctor waved his hand as an adieu on leaving the shore, he imitated the movements with frenzy. He also imitated him as he whistled a European tune.

On another occasion the doctor had introduced to him an old and highly respectable woman, with whom he talked for ten minutes without noticing anything abnormal. All of a sudden the person who brought her took off his coat, upon which she began to undress, and would soon have been quite naked, if he had not stopped her. She was furious against the man who incited her to this indecency, and while she was taking off her clothes, abused him as "an abandoned pig," and wanted him killed. Another case ended tragically. The cook of a steamer was *latah*, and one day was nursing a child, when a sailor came near him with a billet of wood in his arms. He rolled the wood on the top of an awning, and loosening it let the wood fall. The cook did the same with the child, and killed it. At Singapore another *latah*, seeing his mistress tear a letter and throw the pieces out of window, did the same with a bundle of new clothes he was carrying.

The disorder is not confined to warm climates. It is known in Siberia, and a case is mentioned of the pilot of a ship on the Ussar who could not refrain from imitating actions or noises made by the passengers to try him. The captain had a fall while clapping his hands, whereupon the pilot clapped his, and fell in the same way. The Russians call the complaint *miryachil*, and it is said to be common near Yakutsk in severe winters. S.

American Telegraphy.—There were 42,917 telegraph offices in the United States in 1882. The number of telegrams forwarded during the year was 40,581,177.

PARADOXISTS IN AMERICA.

By Richard A. Proctor.

ONE of the most remarkable features of American newspapers is the attention directed in them to men of the paradoxical turn of mind. Our Hampdens, Parallaxes, and Newton Crosslands ought to cross the Atlantic if they wish to receive the amount of attention which doubtless they consider their due. At Montreal lately there died a man named Vennor, who had posed as a weather prophet, with the usual amount of success, for several years. His predictions were quoted over the length and breadth of the United States, as well as of British America, and he was regarded (if we can judge from newspaper comments) as a veritable man of science by most Americans. The *Montreal Daily Witness* paid Montreal the left-handed compliment of describing Vennor as "her most celebrated citizen." In Kentucky, a few years ago, there was another charlatan, by the name of Professor Tice, who claimed similarly to be a weather-prophet, and showed an even more marked ignorance of real science in every line of his writing. His predictions were for a long time regarded with approval, although they showed no more than the usual proportion of successes to failures. He was successful as a lecturer, getting fees, in fact, which an English science-teacher of the soundest kind would certainly not command in the old country, nor secure in America unless he had done something which had attracted special attention there. After a while, "Professor" Tice found that his failures were becoming rather too prominent a feature in newspaper notices; so he made a bold stroke for public favour. He invented a planet to account for his failures—an intra-Mercurial planet, of course. He described how, observing the sun one September day, he saw a round spot, which at first he supposed to be only an ordinary sun-spot; but, seeing it was moving across the sun's face, he concluded it must be Mercury. (He had no idea how thoroughly he was thus exposing his ignorance—not, indeed, to the average American paragraphist—but to every one acquainted with the elements of that science in which he pretended to be most profound; a transit of Mercury in September would be as surprising a phenomenon to an astronomer as an eclipse of a crescent moon.) Finding after reference to an almanac that it was not Mercury, he concluded it must be Vulcan, the intra-Mercurial planet discovered by Lescarbault, if that veracious observer's account is to be believed. This idea being conceived, Tice was at once able—such is the force of genius—to assign the true period of Vulcan, so as to combine together Lescarbault's observation, his own, and all those failures of his which wanted a new planet for their interpretation. So ingeniously was this done, that it appeared, on examining "Professor" Tice's own most precious data, that when he saw Vulcan, that planet must have been seen through the sun. This was pointed out in a Louisville magazine, edited by a gentleman much less widely known throughout America than "Professor" Tice, but having the advantage of him in knowing a good deal about science, whereof the professor knew nothing. We heard less about Tice after that, though, doubtless, millions still put faith in him. And now, another of these charlatans has distinguished himself in such a way that American papers have spoken of him as one might speak of a new Newton, though every line he has written shows him to be ignorant of the veriest elements of science. Like Tice, this man—who rejoices in the name of Wiggins, and honours Ottawa by his presence

—has undertaken to predict weather. He terrifies all the unwiser folks in British America and the United States, and not a few who by no means regarded themselves as idiots, by announcing some year and a half since the destruction of every ship on the ocean by a mighty storm, which did not come when he did call for it. But latterly even newspaper paragraphists have noted that Mr. Wiggins's predictions have been unfortunate, to say the least. So, as Tice invented a new planet, and probably Wiggins thought another new planet would not be welcomed with enthusiasm, the weather prophet of Ottawa invented a new moon, not where M. Petit, of Marseilles, thought that another moon may perchance be travelling, to wit, nearer than the known moon, and lost nearly always in the earth's shadow, but far beyond the moon, and invisible because it has no atmosphere! I think the readers of this paper would hardly credit me if I were to tell them of all the silly things Mr. Wiggins said in the preposterous paper in which he announced the discovery of a second moon; but perhaps the most ludicrous notion was that the atmosphere of a planet plays an important part in enabling the planet to reflect sunlight, so that an orb without an atmosphere would not be visible at all. Another absurdity was the statement that Newton could not explain the perturbations of the moon's movements; but that with this outer moon everything could be fully explained—the inanity of which assertion may not be obvious to others, but is simply stupendous even to the humblest students of the lunar theory. It is not, however, the absurd nature of this man's ideas and reasoning that I care to dwell upon. The ways of paradoxers are tolerably well known, and Mr. Wiggins is neither better nor worse than the rest of them. What is really interesting, and I fear significant, is that in many American newspapers the nonsense of a Wiggins, a Tice, or a Vennor, is discussed as gravely as the work of a Draper, a Young, a Langley, or a Newcomb. In a country distinguished by the labours of such men as these, and a host of other steady workers in the fields of science—from men who rank with the best in Europe down to those whom form indeed the rank and file, but are nevertheless sound scientific students—the average newspaper paragraphist is so ignorant that he speaks of the inanities of men who, in the very nature of things, must either be knaves or fools, as though he were dealing with the thoughts of men of sense. They seem unaware of the fact that the mistakes of a Young or a Newcomb cannot be brought into comparison with the notions of even the least foolish (or knavish) among the paradoxers. A stranger taking up an American newspaper in which a man like Vennor is spoken of as "the most celebrated citizen of Montreal," or a Tice as "our distinguished weather prophet," in which a Wiggins, as recently in a paper published in Missouri, figures among the great men of the day, would never suspect, what is in reality the case, that America possesses mathematicians, astronomers, geologists, meteorologists, and chemists, who yield in skill and in the quality of their work to none in Europe.—*Newcastle Chronicle.*

An attempt is being made to obtain subscriptions for enlarging the buildings in Whitechapel of the Working Lads' Institute. These are to comprise Reading, Refreshment, and Class Rooms, Lecture Hall, Technical School, and Swimming Bath. All interested in the social and intellectual advancement of the working classes, who may feel the desirability of providing such counter attractions as are indicated above to street-corner betting and sotting in the public-house, can send their subscriptions to the treasurer, F. A. Bevan, Esq., 54, Lombard-street, E.C., or to the hon. sec., Henry Hill, Esq., jun., 38, Bow-lane, E.C.

TRICYCLES IN 1884.

By John Browning.

(Chairman of the London Tricycle Club.)

SMALL *VERSUS* LARGE WHEELS AND TWO-SPEED GEARINGS.

THOUGH I have for some months written but little for Knowledge, I have been riding tricycles and experimenting with them continuously.

During this season, I have ridden only machines made to my own specifications. The whole of my machines now have wheels either 36 in. or 38 in. in diameter.

Here my experiments in reducing the size of the wheels must stop, for if the wheels were reduced in diameter only two or three inches more, my legs would not clear the axles, nor would my pedals clear the ground.

But, as far as my experience goes, I have found the reduction of my wheels to this extent an unmixed advantage. The machines are lighter, they are stronger, they are more portable, and they travel quicker or with greater ease. To my thinking, only one point worth considering has been urged against the use of small wheels—that is, that their employment would greatly increase vibration, particularly when they were highly geared. I have one machine geared up to 48 in., and another to 52 in. I cannot find that the vibration of these machines is greater than other machines I have been riding, which have wheels of 46 in. and 48 in. diameter, level-geared.

Mr. S. Salmon, who is deservedly considered an authority on tricycles, has had a machine built this year by Hirst, of Croydon, of the Coventry Rotary type, with a 38-in. driving-wheel, which weighs less than one pound to the inch. It is geared up to 57 inches, yet Mr. Salmon assures me that after three months' experience he prefers it to any other machine he has ridden. From this it is evident that small wheels can be adopted with advantage, even with high gearings.

The great obstacle to their introduction is the fact that manufacturers whose patterns have been designed for large-wheeled machines, and who have often a considerable stock of parts of machines and of large wheels by them, dissuade customers from having them, and frequently refuse to make them.

Also in the case of two-speed gearings, manufacturers have made the high speed agree with the diameter of the driving-wheels, and obtained the low speed by gearing down; thus, a machine with 50-inch wheels will run as 50, or when geared down, as 35 inches.

If, instead of this, a machine were made with wheels say 42 inches diameter, geared up to 50 inches and down to 35 inches, it would be stronger, faster, and about 20 lb. lighter.

The Crypto-Dynamic two-speed gearing has not, I believe, had such a success as was anticipated for it, and I notice that the patentees particularly recommended the use of large-wheeled machines. By doing so, I consider they have not given their invention a fair chance, but have stood in their own light, as, by adding weight in the form of a two-speed gearing, and also by increasing the weight of the machine by making it with large wheels, they neutralised the advantage of the gearing; in plain words, what they gave with one hand they took away with the other.

This point I am urging is of great importance just now, as so many manufacturers are bringing out two-speed gearings. Unless some maker of more originality than the rest will depart from the beaten track, we shall have this new and invaluable improvement in machines brought forward in an unsatisfactory form, and tested at a great dis-

advantage. The new two-speed, central-geared Sparkbrook is a well-planned and well-made machine, half spoilt by being constructed on the plan I have described. The Coventry Machinists have, however, introduced a new and very original two-speed machine, in which speed is obtained by gearing up above the size of the wheels, which is the correct principle. It would be unfair for me to leave this subject without saying that Messrs. Humber, Marriott, & Co., Singer & Co., and Starley & Sutton, make most of their machines with wheels from 40 in. to 44 in. diameter, and gear them up according to the requirements of their customers.

A very noteworthy fact in connection with the adoption of small wheels is the wonderful performance of the various safety bicycles, chiefly the Facile, the Sun and Planet, and the Kangaroo. Now, these machines have wheels ranging from 36 in. to 42 in. in diameter, yet their performances in point of speed and of long distances will bear favourable comparison with those of bicycles of the usual make, with wheels from 50 in. to 60 in. in diameter, though all the small bicycles have to contend with additional friction in extra moving parts. This is one of the most powerful, because it is the most practical, argument, I have yet found in favour of small wheels.

Having now had more than a year's experience of two-speed machines, and having three out of my five machines —viz., a Sterling, a Europa, and a Rucker, provided with two-speed gear, I say deliberately that I do not care in future to ride any tricycle that is not furnished with two-speed gearing.

Several correspondents have called my attention to the fact that while I have highly recommended the Sterling it is only a single driver. I have not overlooked that point, but I consider its merits as a most simple and efficient two-speed machine quite over-balance that single disadvantage. Sir John Herschel said, with regard to the correct figure of a curve for the mirror of a reflecting telescope, "that is a good curve which performs well," and I say that is a good form of machine which performs well, and that is the case with the Sterling.

Some objections have been raised against two-speed gearings on the ground of their complication, the uncertainty of their action, their liability to get out of order, and the increased friction they cause. My reply is that my Sterling has never, in the hundreds of reversals I have given it from speed to power, failed to act instantaneously, nor has it ever given me one moment's trouble. I can say the same of my Europa, so far as the speed and power gearing are concerned; and my friend, Mr. Grace, gives the same testimony as regards the Diana of the same makers; while the fact that my two-chain Rucker, with speed and power gear, is by far the fastest machine I have ridden, is a convincing proof that the amount of extra friction produced by the second revolving chain is of no material consequence, and may, in mathematical language, be neglected.

Very soon I propose to give Eades' new tricycle, the Emperor, a trial. This novel machine has bicycle steering, and is central-geared, and is open-fronted above the axle. I am prepared to find that it may require a little practice to develop its best qualities, and to give it, on account of its novelty, the time and attention necessary to form a fair opinion of its qualifications.

The Colonial Exhibition.—The Victorian Mining Department has decided to send to the Colonial Exhibition, which is to be held in London in 1886, a scientific and economic mineral collection representing the geological features of Victoria. A collection which was sent to Amsterdam will be used as a nucleus.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

(*Continued from page* 134.)

CHAPTER II.—THE DIURNAL MOTION OF THE STARS.*

HAVING satisfied himself respecting the character of the sun's diurnal motion, our observer, we will suppose, turns his attention to the celestial objects which make their appearance when the sun is below the horizon.

Among these the moon is the first to attract his attention. I do not propose, however, at present, to devote much space to the diurnal motion of the moon, which closely resembles that of the sun. It may be followed with the instrument represented by Fig. 5, p. 133, without any change whatever, either in the position of the instrument or in its construction. The only peculiarity which would be noticed would be, that the rate of the moon's motion, though uniform, is not exactly the same as that of the sun's motion, but somewhat slower.

The stars which seem scattered over the whole sky in unnumbered profusion, are the objects to which our observer is now supposed to turn his attention.

A very short time suffices to show that, in the east, stars are rising into view, while in the west stars are setting. More careful observation shows that all the stars visible to the eye are moving with greater or less speed. The stars which rise in the east pass over to the south, where they attain their greatest elevation; and their motion continuing, they pass down to the west, where they set. Stars which rise towards the south of east attain but a small elevation when due south, and set towards the south-west. Stars which rise towards the north of east attain a considerable elevation when due south, and set towards the north of west. Other stars are seen, which neither rise nor set; but appear to travel in circles around a point on the northern skies. And stars very near that point seem scarcely to move at all.

Such are the general features of the stellar diurnal motions; but our observer is now to inquire what are the exact paths which the stars appear to follow.

He might notice that a star rising in the east attains in the south about the same elevation as the sun when that luminary rises due east. He is led, therefore, to inquire whether the whole system of the stars may not be revolving (really, or in appearance,) after precisely the same law as he had observed in the case of the sun. The instrument which he has constructed to follow the solar diurnal motion (Chapter I., Fig. 5) will serve equally well to follow the sidereal motion, if this suspicion be correct; only the observer must be able to look along the rod L M at a star. He need not, however, remove the circular card at M. He may bore a hole through it, and place another card similarly pierced at the end L of the rod, so that the two holes may be directly opposite each other. If, however, the rod L M is a tube, he can look yet more conveniently at a star through this tube.

Thus provided, the observer directs L M to any star whatever, noticing what division of the card H falls opposite the opening in the upright B. At the end of half-an-hour (say) he again directs the tube towards the star. He finds that to do this he has only to turn the rod F G round on its axis, just as he had done in the case of the sun, and apparently through exactly the same angle. In reality the angle is slightly greater, a matter which will presently be noticed more at length. But the great point to be here

* The word diurnal in astronomy is not used as the converse of the word nocturnal, but is applicable to any motions observed during the twenty-four hours, from noon of one day to noon of the next.

noticed is, that every star in the heavens obeys the law of uniform rotation round the axis F G, precisely as the sun and moon had been observed to do.

This is indeed a most important discovery; and will be found, when we come to examine it, to be full of significance.

In the first place it is to be noted that if the stars were bright points on the inner surface of a vast sphere rotating uniformly around the earth, their motions would be precisely such as we have thus seen them to be. So that the notion entertained of old by Anaxagoras and his followers —that the stars are the heads of nails driven into the concave of a vast dome—however *bizarre* it may seem in the light of modern science, was founded at any rate on an observed relation.

Another notion, somewhat less fanciful, was equally consistent with observed appearances. If a vast spherical crystal shell surrounded the earth, and the stars were bright points fixed within the substance of this crystalline dome, but not necessarily at the same distance from the observer, then the observed diurnal motion of the stars would be accurately reproduced by the rotation of the crystalline shell about a fixed axis through its centre.

Let us carefully consider the points thus suggested. Let us take the case of one of those stars which never set.

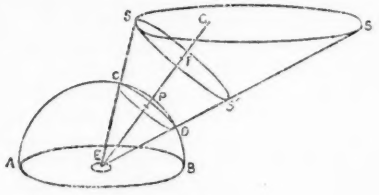

Fig. 1.

Suppose E (Fig. 1) to be a part of the earth's surface (we are supposed to know nothing as yet of the shape of the earth), and let A C B represent the imaginary dome of the heavens on which the stars seem to move. Let P be the point to which the axis of our instrument (F G, in Fig. 5 to Chapter I.) was directed throughout our observations. Further, let C D be the apparent path of a star.

Now our observations showed us the star going round and round in the circle C D, at a perfectly uniform rate. When we saw the star in direction O C, the star must have been somewhere along that line (produced if necessary). Suppose the star was at S. Now where was the star when it seemed to be at other parts of the circle C D? The line of sight went round and round O P, uniformly and keeping always inclined at the same angle to O P. It therefore described a conical surface of which O P was the axis. Now if our star travelled in S S', *a circular section of this cone*, then the star motion really was as equable as it seemed, and the fixed axis O P (produced) passed through the centre of the star's motion at F. But if our star travelled in any other section (necessarily non-circular) as S *s*, then its motion was not equable, but obviously was slowest at S and swiftest at *s*. Also the fixed axis O P did not in this second case pass through the centre of the star's path, but through an eccentric point Q.

We see that the path S S' explains observed appearances *simply*, while the path S *s* requires altogether artificial assumptions of varying motion around an eccentric axis.

But this is only a small part of the difficulties in which we become involved if we give to a star a diurnal motion (relatively to the earth) in any other but a circular path around the axis O P. The path S *s* lies wholly above the plane of the earth's surface at E where the observer is supposed to stand, and, in fact, I have made the oval S *s* parallel to A B, because that is the sort of path by which one of the paradoxists explains the diurnal celestial motions. When, however, we take the case of a star which rises and sets, we get a cone corresponding to S E S', but having part of its surface *below* the plane A B; so that we have to conceive an oval path quite different to S *s*, not only as regards shape and centring, but in position also.

Even this, however, is not all. When we take the case of a star which rises due east and sets due west, the cone corresponding to S E S' becomes a plane. We have, in fact, the case illustrated in Fig. 2, where *e* C *w* represents

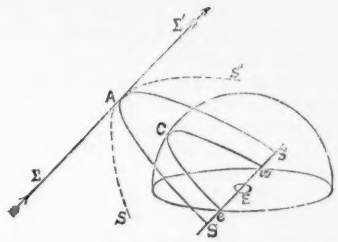

Fig. 2.

the apparent path of such a star on the heavens. Now, in this case, if the true path of the star (relatively to the observer at E) is not a circle (as that of which S A S' is the half), uniformly described, it must either be some other curve *s* A *s'* in the same plane, *not* uniformly described, or if it belong to some other plane *as well* as the plane *e* C *w*, it must be a straight line as Σ A Σ'. For it cannot by any possibility lie out of the plane *e* C *w*, since the line of sight from E to the star is observed always to lie *in* that plane; therefore, if it belongs to another plane also, it must be on the intersection of two planes; and we know that two planes can only intersect on a straight line.*

When we see that so many artificial and incongruous assumptions have to be made if the apparent motions of the stars are to be explained in any other way, we can no longer feel any doubt that the simple explanation suggested by our observations is the correct one. We conclude, therefore, that the motions of all stars relatively to the earth, take place uniformly in circles having one line (E P of Fig. 1) as common axis.

As yet, however, we do not know whether the celestial sphere, carrying all its stars with it, rotates around the earth on this axis, or whether the earth rotates within the celestial sphere, on an axial line in the same direction. We must make excursions over the earth's surface to determine what the figure of the earth may be, before we can form a probable opinion on this point. And before we can feel absolutely certain we shall need yet other observations.

But first it will be necessary to somewhat extend our

* It may be noticed in passing that the sun's course when he rises due east is so very nearly coincident with the course of a star so rising, that the account just given is true appreciably for the sun also; so that if the sun really were travelling parallel to the earth's surface as conceived by one of the paradoxists, he would on March 22 or Sept. 23 (when he rises due east) be travelling in a straight line as Σ A Σ' with a variable velocity saving its least value when he was at A. How he should ever come back again after going off in the direction A Σ', until by the enormity of his distance he appeared close to the horizon (though, strangely enough, looking appreciably undiminished), we may leave to be settled by those who have flattened the earth.

observations of the heavens. Hitherto we have only considered the apparent motion of the sun during a single day, and that of the stars during a single night. We have to inquire whether there are any changes from day to day, and if so, what their character may be. It is clear that until we are certain what the aspect of the heavens by day or by night would be in the place whence we are to start on our excursions, we cannot rightly estimate the significance of the appearances presented in other places.

ELECTRO-PLATING.

X.

By W. Slingo.

TO the amateur or student, one of the most interesting branches of the electrolytic art is the deposition of a metallic film upon the skeleton of a leaf or upon a mould of one. At this point in this series of papers we ought rather to confine ourselves to the preparation of a mould and the deposition of copper upon it. For several reasons, however, it will be found better to take up and finally deal with the finer work that is involved in plating or typing small and delicate objects, such as leaves, insects, and other animal and vegetable matter.

To take an electrotype copy of a symmetrical two-sided animal, such as a herring or other fish, is not difficult. A rather stiff paste of plaster is prepared and poured on to a piece of greasy paper, fastened on a flat board—a rim being provided to prevent the plaster spreading. The fish, having been oiled to prevent adhesion, is laid on the plaster, and then gently pressed in until the lower half is, as it were, enveloped or hidden. The plaster is then allowed to dry until it is well set, although not quite hard, when the object is removed and the edges of the mould finished off with the aid of a knife. Two or three small holes are made in the level portion surrounding the figure. The mould is then brushed over with soap and water, and the fish replaced in its former position. A thin plaster paste is then prepared and poured over the fish and lower mould rather quickly. When quite set and thoroughly hardened, the two moulds, each representing one side of the fish, are easily separated, after which they are placed in an oven to dry. When dry they are treated in the ordinary way—that is to say, they are first saturated with molten wax, and the surfaces, so far as they present an image of the fish, are plumbagoed and connected to the negative electrode of the bath; leading wires are used if the fish, or whatever else the object may be, is thick, or, in other words, if the copy is to be a work in high relief. It would be possible to make arrangements for taking the copy in one piece, but it is preferable to take it in two pieces, and then filing, fitting, and soldering them together.

When the object to be copied is under-cut, or of such a shape as to render the use of plaster impossible—as in the case of, say, a mouse, the elastic-mould process is, as a practical necessity, resorted to. Of course, it would be possible to use plaster moulds, if we divide the copy into four instead of two pieces.

Leaves may be very faithfully and beautifully copied. To take the upper side, a plaster-of-paris paste is prepared, on which the back of the leaf is laid and gently pressed. Some little care is necessary here to ensure a good result. Air-holes must be filled up and the plaster, if necessary, helped into its place by means of a thin stick of wood. When thoroughly set and hard, plumbago is brushed over and melted wax is poured on until a layer of sufficient thickness is deposited. When cold, the wax is separated, coated with plumbago, and placed in the bath; a good electrotyped copy of the leaf results, if the work has been performed with sufficient care. Other substances than plaster may be used for imbedding purposes, such as clay or fine sand. Where, however, a soft substance is employed, it is advisable to make the leaf rigid by coating the back with a few layers of thin plaster, allowing each layer to dry before the successive one is applied. Substances which require pressure cannot be used for moulds, because the surface or shape of the object is liable to damage. Gutta-percha is therefore inapplicable.

The process for plating leaves, flowers, insects, &c., is an interesting one. The object to be coated is first dipped into a solution of phosphorus in bisulphide of carbon. A silver solution consisting of 1 dwt. of nitrate of silver dissolved in a pint of distilled water having been prepared, the object is immersed in it and kept in until the phosphorus has caused an entire coating of silver to be deposited, which will be evidenced by a uniform blackness. After washing in clean water, the silvered object is immersed in a solution of chloride of gold, again washed in clean water, and then allowed to dry. When dry, it is placed in the bath, and a thin copper deposit is taken. If bisulphide of carbon is not available, a silver coating may be obtained by dipping the object in the nitrate of silver solution, and then suspending it under a glass jar or receiver, closed at the top, in which a piece of phosphorus is being burned.

Another method is to grind in a mortar to a fine powder some nitrate of silver crystals, and shake up the powder with alcohol in a flask placed in warm water. One hundred parts of alcohol should take up about $2\frac{1}{4}$ parts of the nitrate. The object to be copper-plated is dipped in the solution, while warm, for a moment, and on withdrawing the alcohol is allowed to evaporate, the nitrate being left on the object. It is then placed in a vessel containing burning phosphorus, when the salt is reduced and the usual conducting coating is provided.

Skeletons of leaves may be treated in the same way as insects or flowers, and beautiful results obtained. The appearance may be further considerably improved by depositing a gold or silver film over the one of copper, of which, however, more anon. I must leave the amateur to work out any special design he may have in view, derived from combinations of leaves, skeletons, and insects, and I fancy that with a little application he may produce, with the aid of various metallic solutions, some remarkably pretty and attractive results.

It is, perhaps, worthy of mention, as an interesting fact rather than as an experiment to be repeated, that E. T. Noualhier and J. B. Prevost, in 1857, introduced a plan to "metallise soft surfaces," such as a human corpse. All the apertures, mouth nostrils, &c., were stopped with modellers' wax, and pulverised nitrate of silver was spread over the body with a brush. It was then placed in the bath, and a copper coating deposited, the "result being a metallic mummy."

The next subject to claim our attention will be the deposition of copper upon the baser metals, glass, &c.

The number of workmen employed in our dockyards at home increased from 1879 to 1884 from 16,381 to 18,849. The armoured building had been advanced from 7,427 tons in 1879-80 to 12,614 tons, as proposed in the Estimates for 1884-85. The expenditure on armoured building for 1883-84 and 1884-85 was actually doubled as compared with 1879-80. For the protection of our vast commerce in every part of the globe we maintain a fleet in commission with an aggregate displacement of 324,256 tons, as compared with 171,300 tons for the French. Our fleet in commission was more than double the tonnage of the French, but our mercantile marine was tenfold larger than theirs.

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

By Edward Clodd.

VII.

In thus far illustrating the confusion inherent in the barbaric mind between what is and what is not external to itself, and the explanation which it consequently gives of such simple matters as a man's name and likeness, the explanation given of matters still dividing philosophers into opposite camps has been hardly indicated. The uniformity of this among the lower intelligence in every zone and age might surprise us, and we should be in bondage to the theory which explains it by assumption of primal intuitions of the race, were we not rejoicing in the freedom of the truth of the doctrine of the descent, or ascent, of man from an ape-like ancestry, and the resulting slow development of his psychical faculties, involving his accounting for motion in things around by the like personal life and will of which he is conscious in himself, and for his regarding the world of great and small alike as the home and haunt of spirits.

For the assumption underlying the savage explanation of such things as dreams and diseases involves a larger assumption—namely, that the spirit which acts thus arbitrarily, playing this game of hide-and-seek, now, as it were, caught up into Paradise, and now dodging its owner and worrying its enemy on earth—is, to quote Mr. Spencer's appropriate term, a man's *other self*. It is, at least, what the scientists call a working hypothesis; it is the only possible explanation which the uncultivated mind can give of what it has not the power to see is a subjective phenomenon. Odd and out-of-the-way events have happened to the dreamer; he has been to strange places and seen strange doings, but waking up, he knows that he is in the same wigwam where he lay down to sleep, and can be convinced by his squaw that he has not moved therefrom all night. Therefore it is the other self, this phantom-soul, which has been away for a time, seeing and taking part in things both new and old. We civilised folk, as Dr. Wendell Holmes remarks, not rarely find our personality doubled in our dreams, and do battle with ourselves, unconscious that we are our own antagonists. Dr. Johnson dreamed that he had a contest with an opponent and got the worst of it; of course, he found the argument for both! Tartini heard the Devil play a wonderful sonata, and lay entranced by the arch-fiend's execution. On waking, he seized his violin, and although he could not reproduce the actual succession of notes, he recovered sufficient impressions to compose his celebrated "Devil's Sonata." Obviously the Devil was no other than Tartini.

Thus the philosopher, to whom dreaming merely indicates a certain amount of uncontrolled mental activity, may satisfy himself; not thus can the savage, who cannot even think that he thinks, and to whom the phenomena of shadows, reflection, and echoes bring confirming evidence of the existence of his mysterious double. What else than a veritable entity can his shadow be to him? Its intangibility feeds his awe and wonder, and increases his bewilderment; its actions, ever corresponding with his own, make it, even more than its outline, a part of himself, the loss of which may be serious. Only when the light is withdrawn or intercepted does it cease to accompany, precede, or follow him, and to lengthen, shorten, or distort itself; whilst not he alone, but all things above and around, have this phantom attendant. The Choctaws believed that each man has an outside shadow, *shilombish*, and an inside shadow, *shilup*, both of which survive his decease. Among the Fijians a man's shadow is called the dark spirit, which goes to the unseen world, while the other spirit, which is his likeness reflected in water or a mirror, stays near the place where he dies. The Basutos are careful, when walking by a river, not to let their shadow fall on the water, lest a crocodile seize it, and harm the owner. Among the Algonquin Indians sickness is accounted for by the patient's shadow being unsettled or detached from the body; the Zulus say that a corpse cannot cast a shadow, and in the barbaric belief that its loss is baleful, we have the germ of the mediæval legends of shadowless men and of tales of which Chamisso's story of Peter Schlemihl is a type. The New England tribes called the soul *chemung*, the shadow, and in the Quiche and Eskimo languages, as also in the several dialects of Costa Rica, the same word expresses both ideas; while civilised speech indicates community of thought in the *skia* of the Greeks, the *manes* or *umbra* of the Romans, and the *shade* of our own tongue. Still more complete in the mimicry is the reflection of the body in water or mirror, the image repeating every gesture and adopting every colour, whilst in the echoes which forest and hillside fling back, the savage hears confirmation of his belief in the other self, as well as in the nearness of the spirit of the dead. The Sonora Indians say that departed souls dwell among the caves and nooks of the cliffs, and that the echoes are their voices, and in South Pacific myth echo is the first and parent fairy, to whom at Marquesas divine honours are still paid as the giver of food, and as she who "speaks to the worshippers out of the rocks." In Greek myth she is punished by Juno for diverting her attention whilst Jupiter flirts with the nymphs, and at last, pining in grief at her unrequited love for Narcissus, there remains nothing but her voice.

But what, in primitive conception, is the more specific nature of the other-self, and how does it make the passage from within to without, and *vice versâ*? Very early in man's history he must have wondered at the difference between a waking and a sleeping person, a living and a dead one, and sought wherein this consisted. There lay the body in the repose, more or less broken, of sleep, or in the undisturbed repose of the unawakening sleep; in the latter case with nothing tangible or visible gone, but that which was once "quick" and warm, which had spoken, moved, smiled, or frowned but a little while before, and which still came in dream or vision, was now cold and still.

It should here be remarked, in passing, that many savage races do not believe in death as a natural event, but regard it as differing from sleep only in the length of time that the spirit is absent from the body. No matter what anyone's age may be, if his death is not caused by wounds, it is attributed to magic, and the search for the sorcerer becomes a family duty, like the vendetta for other injuries. And the widespread myths which account for death have as their underlying idea the infraction of some law or custom, for which the offender pays the extreme penalty. And that personification of it which pervades barbaric thought, whilst undergoing many changes of form, yet retains its hold in popular conception as well as in poetry. Pictured as the messenger of Deity, the awful angel who sought the rebellious and impious, or who, in mission of tenderness, bore the soul to its home in the bosom of the Eternal, it was transformed and degraded by the grotesque fancy of a later time into a grim and dancing skeleton whetting his sickle for ingathering of the young and fair to their doom, or into the grinning skull and crossbones of Christian head-stones.

But to resume. Whilst shadows, reflections, and echoes, one and all seemed to satisfy the uncivilised mind as to the

existence of the other-self, they gave no key to its nature, to what it is like. Obviously the difference between death and life lay in some unsubstantial or semi-substantial thing. Perhaps, thought some races, it lies in the blood, with the unchecked outflow of which death ensues, and the idea of this connection has not been confined to barbaric peoples. Perhaps, thought other races, it lies in the heart, which, say the Basutos, has gone out of anyone dead, but has returned when the sick have recovered. Among the Greeks some philosophers held that it was fire, which was extinct when the fuel of life was burnt out, or water, which would evaporate away. But, as language shows, it is with the *breath* that the other-self of the savage and the vital principle of the philosopher has been most widely identified. For it is the cessation of breathing which would in the long-run be noted as the unfailing accompaniment of death; and the condensing vapour, as it was exhaled, would confirm the existing theories of a shadowy and gaseous-like soul. In this, as the illustrations to be adduced from various languages will evidence, the continuity of idea which travels along the whole line of barbaric and learned speculation is unbroken.

THE WORKSHOP AT HOME.

By a Working Man.

I HAVE been asked by the Editor of this paper to give directions in its columns for the performance of some of those kinds of handicraft which may be practised by the amateur without assistance. I mean the construction of articles of household use, and furniture, in wood (both by the aid of ordinary joiners' tools and the lathe), and the making of simple apparatus in brass, &c., as well, in the last-named machine. I shall begin at the beginning, describe the tools to be employed, and their use, and tell the learner not only what to do, but—what is often of as much consequence—what not to do.

And my first piece of advice will be, "Don't buy a chest of tools." There are certain ones which are essential, which will be found in it; but, on the other hand, it is sure to contain others of comparatively infrequent use, while some which are certain to be wanted, sooner or later, will be conspicuous by their absence. Start with an outfit suitable to your purse, go to a first-class maker, like Buck, Churchill, Fenn, or Melhuish, or (if you are a wealthy man) to Holtzapffel, get just what you require, and add to your

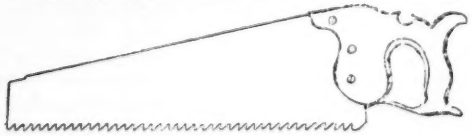

Fig. 1.

original collection as necessity arises. I shall come by-and-by to lathe tools; just now we will confine ourselves to those used by the carpenter or joiner.

Fig. 2.

To begin with, we ought properly to have the three saws shown in the annexed figures; where Fig. 1 represents what is called a "hand-saw," for cutting planking the lengthways of the grain of the wood; Fig. 2, a "tenon-saw," for cutting across the grain; and Fig. 3, a "bow" or "frame-saw," for sawing round curves. A very thin, narrow saw, sliding through a handle (or "pad"), and

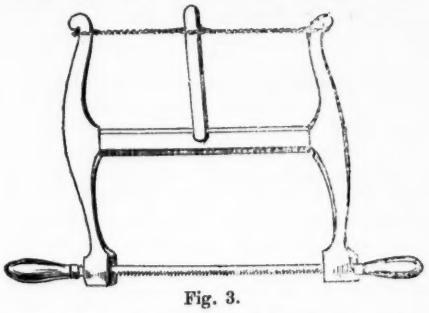

Fig. 3.

called a "keyhole-saw," will sometimes be found useful; but we can dispense with it for the present. Next, we shall require three planes, two of which are depicted in Figs. 4 and 5. Fig. 4 is known as a "jack-plane," and is

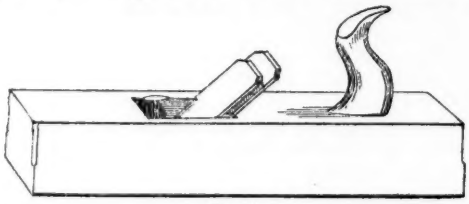

Fig. 4.

used for the first rough planing-up of wood as it comes from the timber merchant. A longer and "finer-set" form of this workmen call a "trying (by which is meant true-ing)

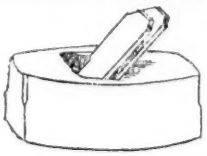

Fig. 5.

Fig. 6.

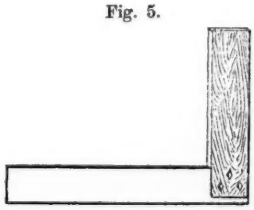

Fig. 7.

Fig. 8.

Fig. 9.

plane." It is used to produce a perfectly flat surface; and Fig. 5 is a "smoothing-plane." In addition to this, there are "plough," "rabbeting" (or rebating), "side filister," "match," "grooving," "moulding," "beading," and divers other planes, to more than one of which I may have to return. Any one of these, though, if wanted for a special job, can be bought subsequently. Then we shall require at least four "firmer" chisels,"—1-in., ¾-in., ½-in., and ¼-in.—(Fig. 6), and a couple of gouges, together with a wooden mallet, four gimlets, three bradawls, a hammer, a square (Fig. 7), a marking-gauge (Fig. 8), and a mortice-gauge (Fig. 9), a two-foot joint-rule, or else a yard measure, an oilstone, a glue-pot and brush, glue, screws and nails; Nettlefold's screws in cardboard boxes and the so-called "French" or wire-nails being the best for the amateur. The tools I have enumerated may

be considered as essential. They will cost as nearly as may be £2. 8s. at a good shop. A carpenter's bench, too, is a great desideratum, but a very firm table will do for smaller jobs, especially if it is placed in the corner of a room so that one end and one side of it abut against the adjoining walls. The amateur who is about, though, to take up carpentering in earnest, had better buy a bench. A new one of sufficient size for ordinary amateur cabinet-making may be bought for five and forty shillings or so, but occasionally a second-hand one may be picked up for much less. Suppose, then, that the reader has provided himself with the tools mentioned above, the next thing will be to learn how to use them in an attempt upon a simple piece of work.

As a preliminary, though, even to this, it is essential that they should, one and all, be very sharp. No good or even decent work ever was done yet with blunt tools, or ever will be; so we had better begin at the very beginning by learning how to sharpen ours. Saw-sharpening the amateur had better not attempt—at all events, for some time to come. It is an art which requires a considerable

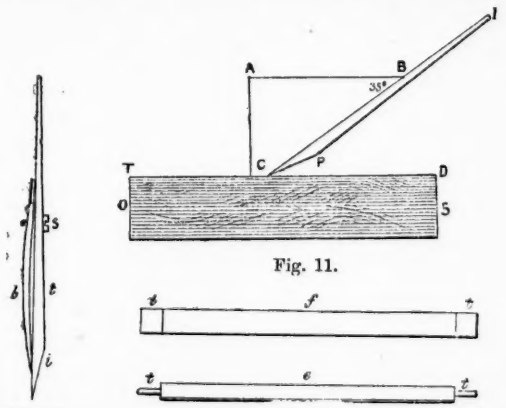

Fig. 11.

Fig. 10.

Fig. 12.

amount of practice; and, besides, he can get them sharpened and set for 3d. a piece; so that the game is really not worth the candle. Using the word "set" just now, reminds me to explain that a saw is set by bending its teeth alternately to the right and to the left of the plane of the saw; so that if we suppose the first, third, fifth, and seventh teeth to bend to the left, the second, fourth, sixth, and eighth, and so on, will be bent to the right. If the reader will turn a saw-edge upwards and look along it, he will see what I mean in an instant. His plane-irons and chisels, though, he must, perforce, sharpen himself. To get out a plane-iron, a long plane (like Fig. 4) should be knocked with a mallet on the front part of the top of it. In the case of the smoothing-plane (Fig. 5) the iron is released by striking the hinder end of the plane. Having got our iron out, we shall find it present the appearance of Fig. 10, where *i* is the cutting plane-iron proper; in front of which is screwed *b*, the break-iron (so called because it breaks the shavings and causes them to curl up). These two irons

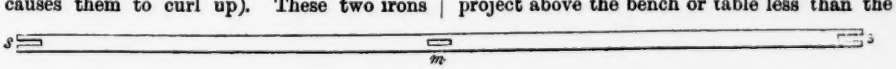

Fig. 13.

are connected by the screw *s*, which must be loosened by a screw-driver until it moves up and down easily in the slot, through which it is to be drawn until the screw-head comes opposite the big round hole at the top of the slot, through which it can be then drawn, and the plane-iron will be free.

Now it will be noticed at once that this iron is sharpened from the back only, its face being perfectly flat, and the angle at which it has been found in practice the best to sharpen it is one of 35° (there are, as everyone knows, 360° in a whole circle, and 90° between two lines that stand square to each other). Any one who knows the XXIXth proposition of the 1st Book of Euclid will see at once the explanation of the little "dodge" I am going to describe. By the aid of the "protractor," to be found in every case of mathematical instruments, we cut out a bit of card A B C with its angle at B=35° and that at A a right angle. If now we put our piece of card so that its side B C shall lie lengthways along the face of the plane-iron P I, and placing the iron on our oilstone O S, Fig. 11, tilt up the plane-iron until the side of the triangle A B is parallel with T D, the top of the stone, we shall have B C D=A B C, or measuring 35°, so that we have only to keep our plane-iron steadily at this tilt to sharpen it accurately. After rubbing it sufficiently we must lay it perfectly flat on its face on the stone, and give it a rub or two to take off the rough or "wire" edge caused by sharpening it from behind. Then we replace our break-iron, and put the plane together again, being careful that the edge of the iron is *only* just visible when the bottom of the plane is looked at edgeways from the front. A firmer chisel (Fig. 6) may be sharpened in precisely the same way. It is almost needless to add that some clean olive oil must be dropped on the stone before we begin sharpening.

Very well. Suppose that we have got all our tools thoroughly sharp and in good order, we will begin by making the wooden frame-work for a three-leaved screen; to be afterwards covered with canvas and scrap-engravings, or bronzed American cloth, and painted with flowers. The three frames, which must, of course, be identical in size and shape, I will suppose to be each 5 feet high by 2 feet wide, the framing being $1\frac{1}{4}$ inch wide and $\frac{7}{8}$ inch thick. In each frame we shall require two upright sides (technically called the "stiles"), each 5 feet long, and three transverse pieces (known as the "rails"), each 2 feet long. This will involve our buying 13 feet 3 inches (or thereabouts) of 1 inch deal planking, which will be 7 inches wide, and must be free from knots. It will, in one sense, cut to waste, *i.e.*, we shall not use it all, but a little reflection will show that we cannot get wood of the dimensions we want out of a smaller plank. It may, though, pretty evidently be in the form of two planks—one 5 feet 1 inch, and the other 8 feet 2 inches. The odd inches are to enable us to cut the ends of our styles and rails truly square, and yet leave them of the right length. Out of our 5 feet 1 inch piece of board we shall (allowing for planing-up) only get five stiles; so we begin by drawing four straight lines on it, equidistant from its edges, and parallel to them and to one another. This will divide the 7 inches of width into five equal strips each, $1\frac{4}{10}$ inch wide. The plane will reduce this width to our adopted one, when it comes to be used. But perhaps in a job like this, we had better plane up our board first; so, laying it on our bench, or a very flat table, with a stop of some sort in front of it (N.B. This stop must obviously project above the bench or table less than the thickness of the board, or it will catch the plane every time), we begin with the jack-plane (Fig. 4), and go all over the board. Having taken off all the dark and rough outside, we finish up with our trying-plane. The amateur must try to plane *hollow*, or his plane will take off too much at each

end of the board, and it will assume a more or less convex outline. From the very construction of the tool, he will fail in his attempt, but this must be the tendency of his planing. When, however, he can take off shavings of the whole—or nearly the whole—length of the board, he may rest satisfied. By looking at the board edgeways, he will see when it is perfectly flat on both sides, and then he must plane the edges too, taking care that they are square to the face of the board. He must try this all along with the square (Fig. 7). Now, then, he can mark his 5 feet 1 inch piece of board into the 5 equal strips, and laying it down on a very firm wooden chair or box, saw it into strips with the hand-saw (Fig. 1). He should pencil the lines along which he is to saw, clearly, and take particular care that the plane of the saw is square to the face of the board. It must be sloped, though, in the direction of its length. Little short cuts may be made at first, and then, when the saw is fairly in the pencil-line, longer ones; but the saw must be watched and brought into the line again, if it shows the slightest tendency to wander from it. In this way, then, must the beginner saw out the fifteen strips of wood he requires, the six "stiles" 5 ft. long, and the nine "rails" 2 ft. long. The edges of these must now all be planed up truly, and the strips cut to their exact lengths by the tenon-saw, the lines defining those lengths being marked by the aid of the square (Fig. 7) and pencil. As I began by saying, the planing should finally leave the strips $1\frac{1}{4}$ in. wide and $\frac{7}{8}$ in. thick. It now remains to fit our frames together. For simplicity's sake, we will make the corner joints like those of the frame of a school-slate. The middle rail, however, must be morticed in. I have said that the thickness of the wood is just $\frac{7}{8}$ths of an inch; so we begin by loosening the screw in front of the mortice-gauge (Fig. 9), separating the little points $\frac{3}{8}$ths of an inch, and then moving up the wooden fence or guide until it is $\frac{1}{4}$ inch from the lowest point, finally tightening all up by the screw again. It will be seen that if now the gauge be run along the edge of the wood, it will draw two parallel lines $\frac{3}{8}$ths of an inch apart in the middle of its thickness. Let us suppose that we have one of our 2 feet "rails" so marked, then at $1\frac{1}{4}$ inch from each end we draw a line truly square round it with the square and pencil, as before, and taking the tenon-saw (Fig. 2), cut along the line marked by the mortice-gauge down to our pencil-mark, and then saw from each face on our pencil-line down to this cut. This will obviously take off two thin slabs of wood, about $\frac{1}{4}$ in. thick, $1\frac{1}{2}$ in. wide, and $1\frac{1}{2}$in. long, and will leave the two smaller ends or "tenons," *t t*, standing as in Fig. 12, in which *f* represents the rail as seen from the front, and *e* as viewed edgeways. In sawing out these tenons the marks should all be *left visible*, and not obliterated by the saw-teeth passing actually through them. Leaving the mortice-gauge undisturbed, we now run it along the edge of our 5-ft. "styles" (Fig. 13), at each end of which we cut with the tenon-saw $1\frac{1}{4}$ inch down into the wood, leaving the gauge-lines visible on that, too, and by the aid of our quarter-inch firmer-chisel clear out the two apertures *s s*. As we went *inside* the marked lines in cutting these out, and *outside* the lines in cutting our tenons, the latter will fit very tightly into them; so tightly, perhaps, as to involve a little delicate shaving or scraping of the tenon before it will enter without splitting the end of the style. This joint may be seen at the corners of an ordinary school-slate. In the middle of the frame, though, at *m*, it is obviously inapplicable, so here we must make a regular "mortice." This is a rectangular opening through the whole width of the style, $1\frac{1}{4}$ in. long and $\frac{3}{8}$ in. wide (the width and thickness of the tenon respectively). Carefully outlining this on both edges of the wood, the amateur had better begin by boring a series of holes in this marked space with the biggest gimlet he has, and then carefully and truly clearing out the rectangular opening or mortice with sharp chisels. If the reader has followed me so far, he will see now that the tenons will drop, with a little pressure or knocking, into the mortice in each rail at *m*, and into the apertures *s s*, at the ends of them. When everything is neatly fitted together, the styles and rails laid in order must be once more separated, the tenons and the holes they are to enter rapidly brushed with fresh, thin, hot glue, and the whole frame put together again as rapidly as possible, tied or cramped tightly together, and set aside for the glue to cool. Finally, the reader may once more get his biggest gimlet, and bore holes through the styles and the tenons, and cutting some bits of deal *very* slightly conical with a penknife, dip them in hot glue, and drive them home as far as they will go. The tenon-saw will trim them off level, or practically so, with the face of the wood, and a finishing touch can be given with the smoothing-plane (Fig. 5). These wooden pins are technically called "dowels." The frame now completed is represented in Fig. 14. Three of these will, as we began by saying, have to be constructed, and they must be united by two pairs of brass hinges (called "butts"), which may be bought, with the necessary screws, at any ironmonger's. Note that they must be placed on—so to speak—*alternate* edges of the frame for the screen to fold properly. It only remains to cover the screen with canvas or American cloth, and this may be nailed on with the smallest tacks or with cabinet-maker's brads. The decoration of the screen with scrap engravings, pasted on to the strained canvas, or with flowers painted in oils on the American cloth, may safely be left to the taste of the reader.

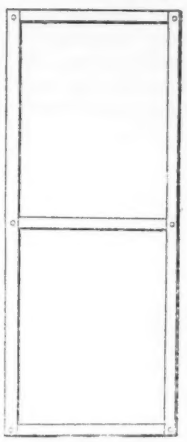

Fig. 14.

THE GREELY EXPEDITION.

By Andrew McPherson.

THE account which was published in Knowledge last week of the doings and sufferings of the Greely band of explorers has been supplemented in an unlooked-for and unpleasant manner. A charge of cannibalism has been preferred against the surviving members of the crew, and, although the charge has not received official confirmation, it has not been met with that categorical refutation which one would wish for. But, after all is said, what does the charge amount to? That cannibalism is in itself abhorrent no civilised being would deny; but to go so far as some of our contemporaries seem disposed to do, is, so far as I can see, uncharitable in the highest degree. I think, rather, that to be so reduced by want of food as to render one capable of overcoming the feelings of revulsion which must present themselves, is indicative of agony of the acutest description, and demands our sincerest pity and commiseration rather than condemnation. As Dr. Rae, a well-known explorer, writing to a contemporary, says:—"It is all very well for those who, probably, have never been twenty-four hours continuously

without food in their lives to enlarge most indignantly on the subject. Had they been for days, as I have, living, or, rather, existing on the smallest scraps of skin and bones, and enjoying the most disgusting-looking food as if it had been the greatest delicacy; had they but witnessed the sufferings and cravings of some of my fine fellows during these times of privation, they would have had some knowledge of what starvation meant."

Charges of bad discipline are also brought, as helping to account for the resort to cannibalism; but such charges require only a moment's consideration to be contemptuously hurled aside. Suffice it to say, that the members of the crew were picked from one of the best-disciplined bodies of men in the States.

We have occurring around us almost daily, suicides and perhaps murders, actuated only too frequently by want of food, and yet we do not give vent to the same feeling of horror that has found utterance against the supposed doings of the unfortunate travellers, icebound and starving.

It is possible, nay more, it is highly probable, that many a similar expedition has in bygone days resorted to similar means to sustain vitality, but surely no pleasure or satisfaction can accrue to a healthy-minded man in peering into and scanning with microscopic eyes all the doings of men when reduced to the greatest extremities to which humanity is susceptible. Let us then rather close our eyes to such pictures, regard the survivors with pity, and do what in us lies to prevent a recurrence of the dreadful episode. It is clear that nothing further can be gained by Arctic exploration—nothing that is which is likely to be of any use to mankind; and it behoves us therefore to discountenance any further expeditions. But, perhaps the most fitting conclusion to these few remarks is afforded by what Mr. Proctor said last week in the *Newcastle Chronicle*.

"The expedition has ended, as many feared that it must end, in the loss of nearly a score of lives, and the probable loss of health and strength on the part of the seven surviving members of the ill-fated party. *Per contra*, some little light has been thrown on the position of certain shores, mountains, and so forth, which will never be visited for any useful purpose by human beings, while the North Pole has been approached nearer by some eighty miles than at any previous Arctic expedition. In what respects such expeditions as these differ from Captain Webb's attempt to swim the Niagara rapids, except that many lives are risked instead of one, it would be difficult indeed to say. The members of the expedition were gallant and enduring men; but Webb was as brave and as resolute. They risked their lives; he risked his. It was certain beforehand that no good could come from Webb's attempt; it was no less certain that no considerable advantage to the human race could accrue from any new Arctic expeditions. A certain element of savagery in our most cultured races, by which importance comes to be attached (goodness knows how) to useless exploits, is exhibited in such attempts. That is all we can say for them."

A NEW VOLCANO.

THE Secretary of the Treasury has received from Captain M. A. Healy, of the United States revenue cutter, *Corwin*, under date of Ounalaska, May 28, two interesting reports by officers of the *Corwin* describing a visit to the recently upheaved volcano in Behring Sea at the northern end of Bogosloff Island, in latitude 53° 55′ 18″ N.; longitude 168° 00′ 21″ W.

This volcano, which is in a state of constant and intense activity, was upheaved from the sea in the summer of 1882, but was not seen by any civilised eye until Sept. 27, 1883, when it was discovered by Captain Anderson, of the schooner *Matthew Turner*. A few days later it was also seen by Captain Hague, of the steamer *Dora*, but no landing upon it was made previous to that by the officers of the *Corwin* last spring.

Dr. Yemans describes it as a dull gray, irregular, cone-shaped hill, about 500 ft. in height, from the sides and summit of which great volumes of vapour were arising At a height of about two-thirds the distance from the base to the apex of the cone, there issued a very regular series of large steam-jets, which extended in a horizontal direction completely across the north-western face of the hill. Around these steam-jets were seen upon nearer approach deposits of sulphur of various hues, which at a distance had looked like patches of vegetation. A landing was effected without difficulty upon a narrow sand spit connecting the new volcano with the old island of Bogosloff, and Dr. Yemans and Lieut. Cantwell undertook the ascent of the smoking cone. It was covered by a layer of ashes formed into a crust by the action of rain, which was not strong enough to sustain a man's weight, and at every step the climbers' feet crushed through it, and they sank knee-deep into a soft, almost impalpable dust which arose in clouds and nearly suffocated them.

As the summit was neared, the heat of the ashes became almost unbearable. A thermometer buried in them half way up the ascent marked 196°, and in a crevice of the ramparts of the crater "the mercury rapidly expanded and filled the tube, when the bulb burst, and shortly afterwards the solder used in attaching the suspension ring to the instrument was fused." The temperature was estimated at 500° F. On all sides of the cone were perforations through which the steam escaped with more or less energy, and in some cases at regular intervals like the exhaust of a steam engine. The interior of the crater could not be seen on account of the clouds of smoke and vapour which filled it.

"A curious fact to be noted," Lieut. Cantwell says, "in regard to this volcano is the entire absence, apparently, of lava and cinder. Nowhere could I find the slightest evidence of either of these characteristics of other volcanoes hitherto examined in the Aleutian Islands." Volcanic dust or ash, however, is thrown out in considerable quantities, and carried by the wind to places as distant as Ounalaska. After carefully measuring the volcano, and photographing it from various points of view, the exploring party returned, without accident, to the ship. Captain Healy reports his intention to visit the new volcano again on his return from St. Michael's and the Arctic.—*Kansas City Review of Science and Industry.*

THE WESTINGHOUSE BRAKE.

By "Trevithick."

A FEW weeks since I commented upon one or two of the relative features pertaining to the various brakes used in railway working. It has, of course, been apparent from the time when the first train was started, that an efficient brake would, sooner or later, be an essential feature in railway working, and Stephenson, having this fact in view, patented fifty years ago a steam brake to be applied to the engine by the driver. The increased length of trains, their multiplicity and high speed, require something more than this. Several brakes have been introduced, which may be divided, as I have previously indicated, into two classes, viz., Local (that is, operative on the individual vehicle only) and Continuous. The local

brakes are very rapidly dying out, and in all probability will soon become things of the past, so far at least as railway working is concerned. The continuous brakes may be subdivided into two sections, which may be denominated automatic and non-automatic, terms sufficiently clear to explain themselves. It is to the automatic that attention is now drawn, and the Westinghouse is taken as the specimen, although, as will be seen presently, it is nearly without a peer.

The Westinghouse Automatic Brake, named after the patentee, is worked by air pressure. A small, but powerful, air-pump is placed on the engine, and with the aid of steam derived from the locomotive boilers, air is forced either into a reservoir under the foot-plate of the engine, or through a one-inch pipe extending throughout the length of coupling with similar pipes on the adjoining vehicles. A branch-pipe connects E with an essential and eminently interesting piece of apparatus called the Triple Valve, F, which is in reality the controlling piece of mechanism, and of which Fig. 2 is an enlarged view. Enclosed in a case, 1, is a piston, 5, carrying with it a slide-valve, 6, which covers the port, *a*, to the brake cylinder, and in the position shown establishes a communication between *a* and the atmosphere by the exhaust-cavity *b* and passage *c*. Compressed air from the main pipe E enters the lower part of the case, and forcing up the piston, 5, feeds past it into an auxiliary reservoir (G, Fig. 1) through the groove *d* (Fig. 2) and the outlet C. This reservoir is thus filled with air under a high pressure (the same as that in the main pipe), and as things now are, this air cannot escape.

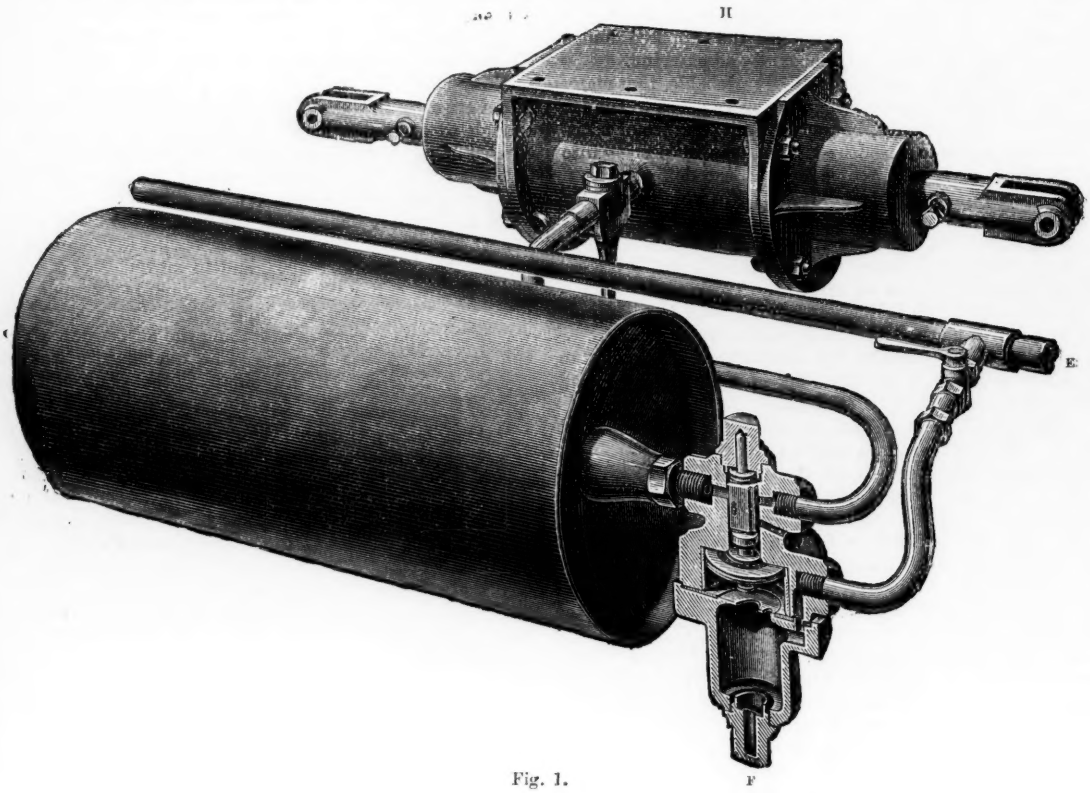

Fig. 1.

the train. The pump is entirely under the control of the engine-driver, and he is at liberty, by simply turning a handle, to connect it with his reservoir or with the pipe. He is also able to connect the pipe with the external atmosphere, so as to reduce more or less completely the air-pressure in the pipe, which nominally is about 70 lb. to the square inch. The pump and its appurtenances, however, need not further detain us, as nothing essential to the proper working of the system is involved; all that is required being a means of rapidly raising the pressure in the pipe, of easily exhausting it, and of speedily re-establishing it.

Let us turn our attention to the brake proper. The accompanying illustration will materially help us. Fig. 1 is a general representation of the apparatus as applied to every individual vehicle. A one-inch pipe, E, which runs the length of the carriage, is connected by an ingenious

At the same time, the slide-valve (6) covers the port *a*, leading to the "brake" cylinder (H, Fig. 1), and is in such a position that air from the latter may exhaust through *b* and *c* into the atmosphere. In the brake cylinder are two pistons, which are pressed inwards and almost together by spiral springs; but when the air enters from *a* (Fig. 2), through the short connecting-pipe shown in Fig. 1, it passes into the small space separating the pistons, and drives them outwards. To each piston is attached a rod, which, acting on a lever, presses a friction block against each side of the wheel.

So long as an equal pressure is maintained in the reservoir, triple valve, and brake-pipe, the brakes are off, the brake cylinder being in direct communication with the air, and the springs, therefore, effectually keeping the pistons near each other, and consequently the friction-blocks clear of the wheels; but on the pressure in the main

pipe and beneath the piston, 5, being suddenly reduced, the piston falls, and by so doing shuts off both the reservoir from the main pipe E and the cylinder from the exhaust port D; at the same time the passage from the reservoir to the cylinder is open, and air passing from the former to the latter, the brakes are applied.

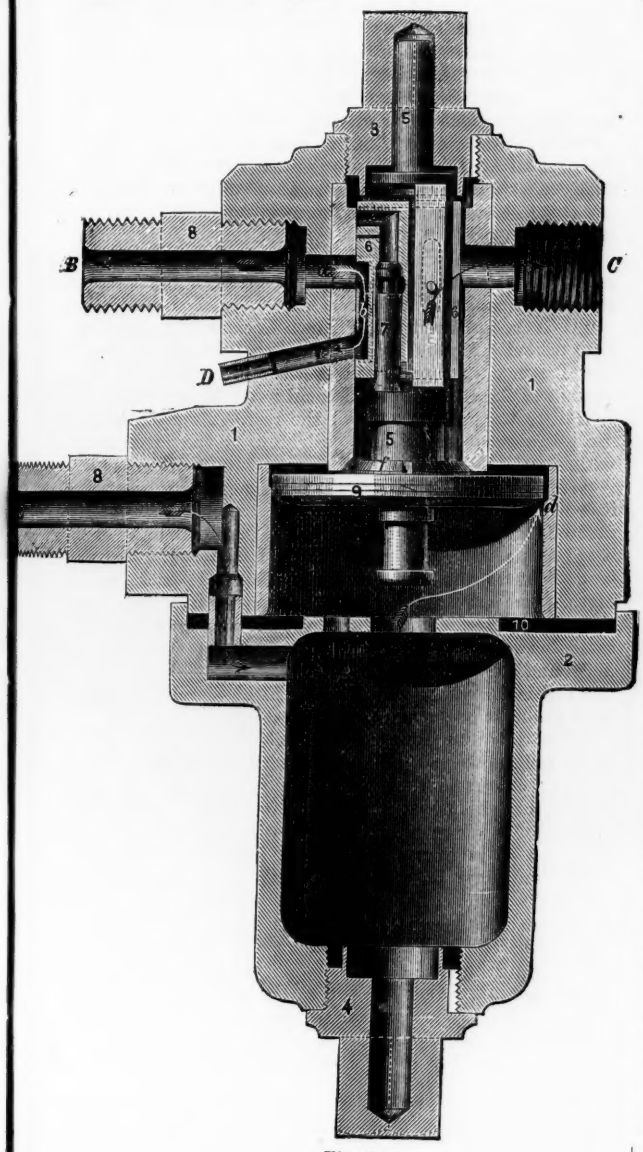

Fig. 2.

For the purpose of graduating the brake with the greatest nicety, that is to say, normally when approaching a station, a small valve, 7, is introduced into the slide-valve, 6. The action is as follows:—Upon a slight reduction of pressure in the brake-pipe being made, the piston, 5—having a limited movement, without affecting the slide-valve, 6—will descend, thereby closing the feed-groove *d*, at the same time unseating the valve, 7, which thus opens the passage *e*. The slide-valve, 6, then moves until the passage *e* opens into port *a*, leading to the brake-cylinder, the communication from which to the exhaust is at the same time cut off. The further downward movement of the slide-valve, 6, is arrested by the decrease of pressure above the piston, caused by the air flowing into the brake-cylinder. So soon as the pressure in the reservoir is thus reduced a little below that in the brake-pipe, the piston, 5, moves up of its own accord, and closes the valve, 7, while the slide-valve, 6, retains its position. By simply regulating the reduction of pressure in the brake-pipe, and causing the motion of the piston and graduating-valve, 7, to be repeated, the driver can gradually introduce any desired pressure into the brake-cylinder from zero up to full power. However, if a considerable reduction of pressure in the main pipe is suddenly made, the piston, 5, is seated on the leather gasket, 10, while the port *a* is entirely uncovered, and the brakes are thus applied with full force.

To release the brakes, air is again admitted from the main reservoir to the brake-pipe by means of the driver's valve. This store of power acting against the reduced pressure in the small reservoirs, forces the piston, 5, into the position shown, thus permitting the air in the brake-cylinders to exhaust, while at the same time the reservoirs are recharged.

To prevent such application of the brakes as might result from ordinary leakage in the brake-pipe, a small hole runs from the face of the slide-valve to the passage *e*. In such a case a piston and slide-valve descend very slowly, and as the port *a* is open both to the exhaust cavity, *b*, and the leakage hole during the first portion of the stroke, air from the reservoir is able to escape by this means into the atmosphere, instead of passing into the brake-cylinder. The reduction of pressure thus caused above the piston, as already explained, prevents the slide-valve from moving far enough to close the communication between the port *a* and the exhaust cavity *b*.

The only moving parts of the triple valve (*an ordinary piston and slide valve moving together as one piece*) do not make as many motions in fifteen years as are made by the piston and slide-valve of the locomotive in one day; hence their durability is beyond question, and this is confirmed by many years' experience.

A stop-cock is placed in the branch-pipe (between E and F, Fig. 1) for the purpose of closing the connection with the triple valve on any one vehicle without interfering with the operation of the brakes upon any other. A release valve (inserted in the tube connecting F with H, Fig. 1), operated by hand from either side of the train, may be opened to allow the air to escape direct from the brake-cylinder if necessary.

The reservoir space is about five times that of the brake-cylinder, consequently, a reduction of 20 per cent. in the brake-pipe pressure fully applies the brake, each pound reduction of pressure in the brake-pipe producing several pounds per square inch in the brake-cylinder. By the action of the triple valves, moreover, the brakes cannot be released without re-charging the small reservoirs, and owing to these features it has been found in working that the store of power is practically never-failing.

It is evident from what has been said that if by any means air is allowed to escape from the main-pipe, the brake must be brought into action, whether it is required or not. This fact constitutes the one great recommendation of the brake to the travelling public, which, I apprehend, embraces the vast majority of our countrymen. We are not so much interested in bone-shaking stoppages at stations, as we are in being arrested on what might otherwise be the high-road to destruction. The brake may be relied upon to operate within 200 yards when running at fifty miles an hour. It is not, however, in such cases only that

the need for a brake exists. In the event of a train dividing, more especially when on either a rising or a falling gradient, it is important that the brake should be applied instantly to every section of the train. It may be taken as a certain eventuality that if a carriage gets off the rails, the couplings will be broken, together with the brake-pipe. The rupture of this pipe, however, causes an instantaneous reduction of pressure within it to 15 lb., that is to say, to the same as that of the atmosphere outside. The result is that the triple valve is brought into energetic action, is impressed downwards, and opens the small reservoir into the brake-cylinder. The brake is therefore immediately and most firmly applied, and the motion of the carriage arrested *automatically*. Had a device of this kind been fitted to the trains which met with such fatal accidents at Downton, Penistone, &c., there is every reason to believe that the lives of the victims would have been spared, because the carriages would have been so pulled up that they would not have rushed down the embankments as they did, but would in all probability have remained near the rails.

(To be continued.)

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p.* 138.)

THE SECOND EVENING.—THAT THE MOON IS A HABITABLE WORLD.

NEXT morning I sent to the Marchioness's apartments, to know how she had rested, and whether the motion of the earth had not disturbed her? She sent word back, she began to be accustomed to it, and that she had slept as well or better than Copernicus himself. Soon after, there came some neighbours to dinner, who, according to the tiresome rural custom, staid till evening, and were very obliging in going then; for the country also gives a privilege of extending their visit to the next morning, if they are so disposed: when they were gone, we walk'd again into the park, and immediately fell upon our systems. She so well conceiv'd what I told her the night before, that she desired I would proceed without any repetition.

"Well, madam," said I, "since the sun, which is now immoveable, has left off being a planet, and the earth which turns round him, is now become one, you will not be surprised when you hear that the moon is an earth too, and that she is inhabited as ours is."

"I confess," said she, "I have often heard talk of the world in the moon, but I always looked upon it as visionary, and mere fancy."

"And it may be so still," said I; "I am in this case as people in a Civil war, where the uncertainty of what may happen makes 'em hold intelligence with the opposite party, and correspond with their very enemies: for tho' I verily believe the moon is inhabited, I live civilly with those who do not believe it; and I am (like some honest gentlemen in point of religion) still ready to embrace the prevailing opinion: but 'till the unbelievers have a more considerable advantage, I am for the people in the moon."

"Suppose there had never been any communication between Paris and St. Dennis, and a cockney who was never beyond the walls of this city, saw St. Dennis from the towers of Notre-Dame, you ask him if he believes St. Dennis is inhabited as Paris is? He presently answers, 'No: for,' says he, 'I see people at Paris, but none at St. Dennis, nor did I ever hear of any there.' 'Tis true, you tell him, that from the towers of Notre-Dame he cannot perceive any inhabitants at St. Dennis, because of the distance; but all that he does discover of St. Dennis, very much resembles what he sees at Paris, the steeples, houses, walls, &c., so that it may very well be inhabited as Paris is: all this signifies nothing, my cockney still persists that St. Dennis is not inhabited, because he sees nobody there. The moon is our St. Dennis, and every one of us as mere cockneys as he that never was out of his own city."

"You are too severe," said she, "upon your fellow-citizens; we are not all sure so silly as your cockney; since St. Dennis is just as Paris is, he is a fool, if he does not think it inhabited: but the moon is not at all like the earth."

"Have a care what you say," replied I; "for if the moon resembles the earth, you are under a necessity to believe it inhabited."

"If it be so," said she, "I own I cannot be dispensed from believing it; and you seem so confident of it, that I fear I must, whether I will or no. It is true, the two motions of the earth (which I could never imagine till now) do a little stagger me as to all the rest. But, yet, how is it possible the earth should enlighten as the moon does, without which they cannot be alike?"

"If that be all," said I, "the difference is not great, for it is the sun which is the sole fountain of light: that quality proceeds only from him; and if the planets give light to us, it is because they first receive it from the sun. The sun sends light to the moon, and she reflects it back on the earth. The earth in the same manner receives light from the sun, and sends it to the moon; for the distance is the same between the earth and the moon, as between the moon and the earth."

"But is the earth," said the Marchioness, "as fit to send back the light of the sun as the moon is?"

"You are altogether for the moon," said I; "she is much obliged to you. But you must know that light is made up of certain little balls,* which rebound from what is solid, but pass through what admits of an entrance in a right line, as air or glass; so that what makes the moon enlighten us is that she is a firm and solid body, from which the little balls rebound; and we must deny our senses if we will not allow the earth the same solidity. In short, the difference is how we are seated; for the moon being at so vast a distance from us, we can only discover her to be a body of light, and do not perceive that she is a great mass, altogether like the earth; whereas, on the contrary, because we are so near the earth, we know her to be a great mass, proper to furnish provision for animals, but do not discover her to be a body of light, for want of the due distance."

"It is just so with us all," said the Lady; "we are dazzled with the quality and fortune of those who are above us; when, do but look to the groundwork, and we are all alike."

"Very true," said I, "we would judge of all things, but still stand in the wrong place; we are too near to judge of ourselves, and too far off to know others; so that the true way to see things as they are, is to be between the moon and the earth, to be purely a spectator of this world, and not an inhabitant."

"I shall never be satisfied," said she, "for the injustice we do the earth, and the too favourable opinion we have of

* We have here a popular account of the emission theory of light, which in Fontenelle's time (it is hardly necessary to say) was regarded as scarcely open to question.—R. P.

the moon, 'till you assure me that the people in the moon are as little acquainted with their advantages as we are with ours, and that they take our earth for a planet, without knowing theirs is one too."

"Do not doubt it," said I, "we appear to them to perform very regularly our function of a planet. 'Tis true, they do not see us make a circle round them, but that is no great matter. That half of the moon which was turn'd towards us at the beginning of the world, hath been turn'd towards us ever since; and those spots in her, which we have thought to look like a face, with eyes, nose, and mouth, are still the same; and if the other opposite half should appear to us, we should no doubt fancy another figure from the different spots that are in it: not but that the moon turns upon herself, and in the same time that she turns round the earth, that is, in a month; but while she is making that turn upon herself, and that she would hide a cheek, for example, and appear somewhat else to us, she makes a like part of her circle round the earth, and still presents to us the same cheek: so that the moon, who in respect of the sun and stars, turns round herself, in respect of us, does not turn at all: they seem to her to rise and set in space of [about] fifteen days; but for our earth, it appears to her to be held up in the same place of the heavens. 'Tis true, this apparent immobility is not very agreeable for a body which should pass for a planet, but it is not altogether perfect; the moon has a kind of trembling, which causes a little edge of her face to be sometimes hid from us, and a little edge of the opposite half appear; but then, upon my word, she attributes that trembling to us, and fancies that we have in the heavens the motion of a pendulum, which vibrates to and fro."*

(To be continued.)

THE INTERNATIONAL HEALTH EXHIBITION.

XIII.—WATER AND WATER-SUPPLIES—(*continued*).

THE excellent filter-case described in our last communication† not only provides for the outflow of every drop of filtered water, but can be taken to pieces and thoroughly rinsed when desired. A glance at the sectional figure (Fig. 22) will explain how this may be accomplished. To the apparatus thus constructed Messrs. Doulton & Co. have adapted the Patent Manganous Carbon Block, which is exempt from the disadvantages of the ordinary "block" principle. The latter are prone to harbour organic and other impurities to such an extent as to render them quite unwholesome. Thus, the Rivers Pollution Commissioners state that "the property which animal charcoal possesses in a high degree, of favouring the growth of the low forms of organic life, is a serious drawback to its use as a filtering medium for potable waters."‡ The Army Medical Report, again, states of charcoal in porous blocks, that, "after a time the purifying power becomes diminished in a marked degree, and water left in contact with the filtering medium is apt to take up impurity again.§

It is well known that carbon is adapted to filtering purposes, on account of its property for appropriating and condensing oxygen, which it parts with to organic substances brought to it, and oxidises or burns them up. Animal charcoal is peculiar in its decolourising or bleaching effects, and vegetable charcoal has the power to deodorise. A combination of the two deprived of all adventitious matters is, therefore, of the highest value to filter manufacturers who seek to purify water for drinking. To entirely discard such a valuable medium would indeed be to "fly in the face of Providence." The problem which here arises may be solved in either of two ways:—(*a*.) The purified mixture of carbon should be such as to provide for a constant reparation of its properties; or (*β*) It ought to be easily replaceable at a very trivial cost.

We have already stated that experiment has shown the "block" system to be faulty, because it soon becomes overtaxed, and no amount of boiling or scrubbing can restore it to its pristine active condition. The only remedy is to be sought for in a renewal of the block, but the frequent necessity for such an operation has the great disadvantage to be a very expensive process. Such was the state of affairs when the block system "ruled the roast," that the domestic filter came to be looked upon either as a troublesome luxury, or, when neglected, as a dangerous contrivance. Yet the necessity of an efficient household water purifier made itself sorely felt, and Messrs. Doulton & Co., as one of the oldest and most celebrated firms of filter manufacturers, felt themselves called upon to remedy matters. They consulted Dr. Albert J. Bernays, F.C.S., the Professor of Chemistry at St. Thomas's Hospital, and the result of his researches, which extended over a period of three years, is now embodied in their "Patent Manganous-Carbon Filter." Fig. 25 shows one of these filters

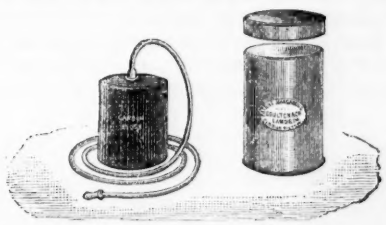

Fig. 25.—Doulton's Patent "Manganous-Carbon" Block Syphon Filter and Case. For the use of tourists and explorers.

as adapted to the use of tourists and explorers. The carbon block can be immersed in any pond or stream, and a draught of pure water sucked through the flexible tube. These filters may also be used upon the "Syphon" principle; the block may be placed in a pail of water, and the flexible tube permitted to hang over its side, below the level of the block; once set going by suction, their action thereafter becomes continuous.

The value of manganous-carbon as a filtering medium has been set forth by Messrs. Doulton in their prospectus, in the following outline of its reactions:—"With the object of rendering the charcoal pure in the manganous-carbon filter, each grain of the medium receives a coating of manganese dioxide, and is then reburnt at a high temperature in absence of air. By this means the hydrogen-bearing impurities are oxidised and removed. At the same time the manganese dioxide is reduced to a lower oxide. These lower oxides rapidly reabsorb oxygen from the air, becoming again converted into hydrated dioxide, which, in its turn, yields oxygen to the organic matters present in the water. Thus the manganese acts as a carrier of oxygen from the air to the impurities in the water, oxidising or burning up the latter, *and then again becoming revivified by the atmosphere.* Manganese also exerts a preventive influence on the growth of organisms, the

* Of course the lunar vibrations are not real tremblings, as here described. They arise, in fact, from the uniformity of her rotational motion, combined with her steady, though not absolutely uniform motion, on a path slightly inclined to the plane of her equator.—R. P.

† *Ut supra*, p. 139. ‡ "Sixth Report," p. 220.

§ "Army Medical Report," XIX., p. 170.

result being that the charcoal, purified by the treatment, and increased immensely in oxidising power by the carrying action of the manganese, *acts better and lasts longer than any ordinary charcoal could.* This was proved by one of the early experimental filters of manganous-carbon, which ran for *two years* with ordinary water, and then, on taking to pieces, showed the charcoal perfectly sweet, and with no objectionable appearances under the microscope. The organic impurities had evidently been burnt up, not simply separated by straining: in the latter case, they would have remained in the charcoal." . . . "Manganous-carbon has a developing or increasing power of agency, and improves greatly after short use, as the lower manganous oxides gradually assume a flocculent and highly active peroxidised condition. The activity then remains for a long time unchanged, depending, of course, much upon the quality of the water."

It will be gathered from the above that the block is kept perpetually sweet and clean, by exposure to the influence of the atmosphere, and upon this depends the advantage to be gained by the use of manganous-carbon. Two blocks are supplied, if desired, with each filter, so as to allow of a weekly or fortnightly change for purposes of aëration.

Type III.—The "Silicated-Carbon Patent Movable Block Filter," as its name implies, is also constructed upon the "block" principle, and finds a place here, because it too has survived the severe ordeal to which filters are subjected now-a-days. All the working parts of the filter case are made of stoneware, and are hence incorrodible; the tap is placed on a level with the lowermost stratum of the reservoir, and the entire apparatus admits of being taken to pieces and easily cleansed. The mechanical details of these filters may be readily understood by a reference to Fig. 26. It may be observed that in Fig. 26, A, the direction of the passage of the water through the

Fig. 26.—The Silicated-Carbon Movable Block Filter. A. Longitudinal Median Section. B. Interior view.

block is indicated by a series of arrows; this is caused by the novel construction of the block itself, the top and edges of which are made of non-porous material, so that the water is forced to pass through a maximum amount of the carbon. The block, moreover, is bolted down on to an asbestos seating, which is made to form a water-tight joint.

The company have informed us that—"*Silicated Carbon* is an admixture of carbon, iron, silica, and alumina in ascertained proportions; the carbon being Torbane Hill mineral, from which the oil has been abstracted." Professor Wanklyn states* that his confidence in the filter is such, that he has passed a solution of strychnine through it, and then drank the filtrate. His explanation of its action is as follows:—"It is an energetic oxidising process, very like the action of the strongly alkaline solution of permanganate with which we are in the habit of boiling the nitrogenous organic matters in drinking-waters. Just as by working the ammonia process we make the nitrogenous organic matter contained in water yield ammonia, so the Silicated Carbon Filter breaks up nitrogenous matters and makes them yield ammonia. In fact, it is possible to work the ammonia process of water analysis *by means of a Silicated Carbon Filter*, instead of the boiling alkaline solution of permanganate of potash."* Its lead-removing property has been commented upon by Dr. Bartlett and others, and experiments have shown that it even softens water to an appreciable extent.

* The *Echo*, Aug. 9, 1884.

BRITISH SEASIDE RESORTS,

FROM AN UNCONVENTIONAL POINT OF VIEW.

By Percy Russell.

III.

PASSING from Bangor, famous for its slates and the tombs of veritable Princes of Wales, with its long crooked streets, in a fertile valley, guarded by steep heights, and proceeding eastwards, we reach Conway, the historic seaport of Carnarvonshire. Here can be studied some fine examples of ancient municipal fortifications, and the Castle is allowed to be the finest example of such structures in Great Britain. Some of the walls are nearly four yards thick. A "sight" of this place is the Plâs Mawr, *i.e.*, the Great Mansion—a stately pile dating from Elizabeth, and most curiously adorned without and within by heraldic devices. Conway contains the tomb of the Great Llywelyn, and to Welshmen is on that account a sacred city. The river is here, at spring-tide, full half a mile wide, and from the days of the Romans has had a reputation for pearls. The coast now takes a sharply northern direction, and brings us to one of the nineteen great headlands of England and Wales, Great Orme's Head. This striking natural feature lies about five miles only north-east of Conway, and is an immense mass of limestone rock, rising to a height of nearly 700 feet, and surmounted by a lighthouse. East of this remarkable feature of the coast is Llandudno, with its soft airs and fine bathing, and passing Abergele and Rhyl, and still working eastward, we now reach the noble tidal estuary of the river Dee, which the ancient Britons, by the way, regarded as a sacred stream. The estuary of the Dee is nine miles long, and at seasons full six wide, and is hallowed to the students of Milton as the fatal shallow where "Lycidas," or, in plain English, Mr. King, the friend of the poet, suffered shipwreck and death.

Parkgate, little known to the ordinary tourist, is a small watering-place competing with the better-known Mersey resorts for visitors from Liverpool. No purer air can be found in England than that blown over the beautiful Dee and down from the Welsh hills, while the lovely scenery of North Flintshire and the splendid expanses of the estuary here give Parkgate a strange charm for all who love Nature in her picturesque phases. At times, indeed, and especially at low water, the estuary becomes in great part a vast waste of sand and ooze, and then aptly enough reminds one of the dirge-like song in Kingsley's famous Chartist novel or political pamphlet—

> Oh, Mary, go and call the cattle home,
> Across the sands of Dee.

Seen, however, with the tide in, the estuary is a grand

* In a paper read before the "British Medical Association," at Sheffield.

expanse, and fit for the haven of commercial fleets. This was, I believe, the Seteia Æstuarium of Ptolemy. About a century and a half since the Dee from Queenferry to Chester was embanked, and thereby the agricultural area of these islands gained about 50,000 acres. For persons of true pedestrian tastes, a ramble from Parkgate to Hoylake along the high ground parallel with the coast here has great charms, and in the vicinity may be seen the favourite resorts of many of the merchant princes of Liverpool.

Birkenhead—which originated in a Benedictine Priory of the twelfth century, possessing the important monopoly of the ferries over the Mersey—is a place of commerce, and in its present aspect in no way resembles the Berkin de Birchen of Edward III. Then one vast, beautiful forest extended in leafy luxuriance from the Dee to the Ribble, and thus amply justified an old local distich—

> From Birchen haven to Hiltre
> A squirrel might hop from tree to tree.

The shores of the Dee, by the way, are memorable as the place whence the English freelances and other worthies of the feudal time used regularly to set out for excursions to Ireland—excursions which, doubtless, sowed the fatal seeds of nineteenth-century Fenianism.

Traversing the coast at Bidston Hill is the historic Liverpool Observatory. I say historic, for here all the chronometers go to be regulated, and the equatorial of twelve feet focal length and eight and a half inch aperture, with other special scientific appliances, are worthy to be duly chronicled—more so than the doings of many of the iron-clothed gentlemen who found these remote shores a good place for rendezvous when on spoliation bent. From the lighthouse here a magnificent view can be had both of the estuaries of the Dee and of the Mersey, of Liverpool, that lordly seat of British commerce; of Birkenhead, Seacomb, Hoylake, Flint, a long and grand expanse of distant Welsh mountains, and, nearer to the gazer by far, New Brighton, which is just a pretty medley of seaside houses and hotels standing on a sandy promontory north of Birkenhead, and commanding extensive and lovely views of the Irish Sea. The lighthouse here is constructed of Anglesea granite, and cemented with a peculiar volcanic substance, brought, I am told, from Etna, and possessing the useful property of hardening more and more with the lapse of time.

One place on this coast must not be overlooked, that is Leasowl Castle, a singular quaint erection near a shoal known as Mockbeggar Wharf. This spot is associated with a racecourse, and as long ago as 1593 races were run here, and it was about then that Ferdinand, Earl of Derby, built Leasowl as a sportsman's lodge. It is said that the unfortunate Duke of Monmouth was prominent in one of these races in 1683, and once on a time Leasowl was quite a centre of Lancashire fashion. Although the magnificent forests which once clothed these shores in such sylvan beauty have long since perished, ample traditions thereof remain in the neighbourhood, and in the hall at Leasowl are preserved specimens of the *Cervus elephas*, not to speak of fibulæ and rings which silently remind us of the grandest civilisation of the Pagan world.

We now enter the region of the great Pennine range, that vast expanse of lofty moorlands and enormous masses of hill and mountain stretching south of the famous Cheviot hills. These ranges lie much nearer the Irish Sea than to the North Sea, and reach considerable altitudes—Cross Fell being 3,000 ft.; Mickle Fell, 2,591 ft.; Whernside, 2,414 ft.; and Ingleborough, 2,373 ft. above the sea level. The Cumbrian group of mountains lie in the west of the Pennine Chain, which is, in a manner, continued right down to the Cornish highlands, and is bound to the main range by lofty moorlands, beginning near Whernside. These moorlands dip and form the striking pass of Shapfell—the commercial road between all West England and Scotland—and north of Shapfell is the broad and beautiful valley of the Eden, ending in the famous estuary of the upper portion of the Solway Firth. Southward is the narrow estuary of the River Lune, on which stands Overton, whose inhabitants have become celebrated through their quaint petition, that, being surrounded by the sea twice every twenty-four hours, they might have a minister of their own instead of being obliged to go to Heysham. The Lune, which gave its name to Lancaster, doubtless, as antiquaries tell us, the Lengovicum of Roman days, flows into Morecambe Bay, one of the most beautiful indentations of the whole English north-west coast. Inland, within the wild and picturesque region bounded by the Lune on the one hand and the Solway Firth on the other, soars up in great grandeur a compact and somewhat circular mass of mountains, precipitous in general upon their northern and western faces, but subsiding gently to the wide sweep of Morecambe Bay in long and easy declivities. From the centre of this group, which imparts such a distinctive and romantic character to the north-west of England, there soars up the "mighty Llewellyn" (3,118 feet) as Scott calls it. Then there is the famous Skiddaw (3,054 feet), embalmed in the somewhat obsolete poetry of Southey, and Scafell, already mentioned, the loftiest peak in all England; and southward the hills slope away into the sea in the picturesque peninsula of Furness. Within, of course, is the great series of lakes, but with these I have here no concern.

Returning to the shore I note that on the pretty peninsula formed by the mouths of the Lune and the Cocker may be seen the ruins of Cockersand Abbey, once occupying the third place among the proud array of Lancashire monasteries, and, subsequently to the Reformation, falling into the possession of the Dalton family, who raised a whole regiment of cavalry for the service of Charles I. All along the coast, or but a little way inland, are to be found objects of great interest to archæologists.

Morecambe Bay receives the waters of the Lune, the Keer, the Winster, the Kent, and the Leven rivers, and is set in the midst of some of the very finest scenery in these islands. The coast is remarkable for its very picturesque sinuosities, and is characterised by its many lovely valleys, its noble parks, and in many cases rich woods, that come down to the very shores. The towns on or near the coast are mostly ancient, and all are rich in historic associations and generally abound in archaic remains of great and enduring interest; and in few, if any, regions of England are such truly picturesque villages to be found.

When the tide is out the enormous stretches of sand form an extensive plain which, in olden days, was traversed by the famous "Over sands" coach running from Lancaster to Ulverston. But the route was always perilous, consequent on the shifting nature of the sands and the action of the rivers flowing into the vast Bay. In one churchyard alone are the graves of over one hundred persons drowned while attempting, at dangerous seasons, the passage of the alluring but treacherous sands; and many are the legends current in the locality of hair-breadth escapes and romantic episodes connected with the far-stretching Bay. The railway constructed across the bend of Morecambe Bay ranks high as among the most remarkable achievements of modern engineering science, and was beset with extraordinary difficulties. The works are a monument of the genius of Mr. Brunlees, and have resulted *inter alia* in restoring land to agriculture where for generations fishermen cast their nets. The whole region abounds in places of interest,

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but for the greater part these are but little known, popularly speaking, in southern England.

The fishing-villages on some parts of the Lancashire coast are remarkable for the utterly primitive habits of the inhabitants, and for the large quantities of flounders and shellfish here taken. All along the wild shores of this beautiful region may be seen the picturesque limestone cliffs, mingled with hanging woods, peaceful-looking, fresh grassy mounds, and far away in the grey distance are the lofty mountains and elevated moors—virtually uninhabited stretches of country, swept by perfectly pure and fresh breezes, and equally refreshing to body and mind.

Barrow, the port whence the famous iron ore of the Furness district is shipped, lies on the coast of the peninsula, and is opposite a little island which tradition tells us was once a burial-place for the Norse Sea Kings. Until 1847 this place was only a small fishing-village, having barely 300 inhabitants, but in 1875 it had increased to 40,000, and now the docks and the various iron and steel works render this town one of the great sights on the Lancashire coast. Furness Abbey gives in its remains the finest examples extant of mediæval ecclesiastical architecture. It was formerly one of the most powerful of the great religious establishments of England, before, as Scott tells us, the ire of a despotic kind made altar shake and crozier bend. The landed property of the abbey once included the entire promontory on which it is situated, and extended to the river Duddon, whose beauties Wordsworth has crystallised for evermore in some of his exquisite sonnets. This domain was about equal to the area of the Isle of Man, and the Abbey could, and frequently did, send over a thousand regular troops into the field, sending, by-the-by, a large contingent to Flodden Field under Sir Edward Stanley. On the hill commanding the Abbey there was formerly a beacon, and thence alarm fires were flashed right across Morecambe Bay as far as the grim towers of Lancaster Castle. The Abbey has a very fine transept, and many very interesting monuments, and for full four centuries these proud and lordly representatives of what was emphatically a Church Militant held imperial sway far and wide. The last abbot was, if I mistake not, Roger Pyle, who surrendered his authority to Henry VIII., and thenceforth all the material pomp and circumstance of these lordly priests went to decay. For the last three centuries the rooks have occupied the ruins, which have been preserved from further decay by the Duke of Devonshire. These remains furnished subject-matter for one of Wordsworth's many fine examples of what may be called topographical poetry, and no one can stand amid these magnificent ruins without feeling some emotion, some touch of that fine sympathy with the past which imparts to every ruin its true pathos.

The Furness District, once the boundary between the Kingdoms of England and Scotland, and the scene of many a tough border scuffle which has found no historian, may be described as in some measure all mountain, and it was in these stern and natural fortresses that the ancient Britons lingered for two centuries and a quarter after the Saxons had obtained the mastery everywhere, except in Wales.

Straightaway due west of the mouth of the romantic River Duddon is the Isle of Man, its southern extremity being in a line with Walney Island, at the entrance to Morecambe Bay. Before, therefore, entering the Solway Firth, and proceeding, as I propose doing, up this wild coast and among the wilder islands of Scotland on the west, I shall rapidly sketch this remarkable island, which, as it richly deserves, is becoming more and more a place of resort for those who desire to be personally familiar with the less known seascape beauties of the British Isles.

Editorial Gossip.

The well-remembered words of Virgil, "Uno avulso, non deficit alter," have had no more literal applicability in recent days than to the succession of shows at South Kensington. With the Health Exhibition in the very height of its popularity; with its innumerable forms of restaurant perennially mobbed by customers; with the instructive popular archæological lesson conveyed by the admirable model of Old London, daily and hourly being learned by the thousands who throng it; with the exhibition of historical costumes scanned by a perpetually densely packed crowd; with the third-rate Cremorne at night in the gardens, where 'Arry smokes his cheap tobacco and Jemimarann exhibits her fringe, her long gloves, and her box-pleated skirt; with the dairy cows in full milk; the sweet-stuff and candle-making machinery in full work; with the bands playing, the lamps twinkling, the steam-boilers hissing, and the dynamos whirling—already is the note of preparation in the air, and the prospectus of the International Inventions Exhibition in 1885 lies before me as I write. Reading through it, it seems as though the bazaar element, so obtrusive in the present show, will be—or rather may be—to a certain extent, modified; and that the Exhibition may possibly assume a more strictly scientific character than the present one. It cannot, however, be lost sight of that the Commissioners of the '51 Exhibition have now become as much showmen as Mr. P. T. Barnum, Mr. Hollingshead, or Madame Tussaud. If turning their buildings into a series of railway refreshment-rooms, or lighting their gardens with "10,000 additional lamps" *pays*, they will furnish the buffets, stick up the little marble tables, and light the lamps. They are merely trying to justify their *raison d'être*, and have hit upon periodical shows as a good device for giving employment to the officials on their estate and of making money. If money can be made by science, all well and good; if not, well, a slight soupçon of the Bartlemy-fair element obviously proves attractive.

The present "glorious weather" (to employ the phrase just now in every one's mouth) brings us once more face to face with the wholly inefficient means we possess in this country for meeting the somewhat violent extremes of temperature to which we are subject. Adapted, perhaps, best to the average warmth of an English spring or autumn, a very severe winter, and perhaps even more conspicuously an abnormally hot summer, shows the weakness at once of our domestic architecture and of our orthodox type of dress. That any human being should disport himself in a "pot" hat and black cloth coat with the thermometer registering 154 Fahrenheit in the sun, must seem almost incredible to any one who does not daily see the unnumbered thousands so attired who throng the streets of the metropolis. But the cult of Mrs. Grundy among Englishmen is so earnest and sincere that the average Londoner would about as soon think of carrying a Punch's show through St. James's-square, or of wheeling a barrow full of periwinkles down Bond-street, as of appearing in either of those localities in a "khaki" suit with a pith hat and "puggree." And what applies to our attire may be equally predicated of our contrivances—or, rather, utter want of contrivances—for keeping our houses cool. Why does not some enterprising tradesman devise something akin to the Indian "tattie," and furnish us with a sun-blind constructed to be kept wet. The delicious coolness produced in the air by the rapid evaporation from such a device must be felt to be appreciated. Nay, even a modi-

fication of the familiar punkah would not be without its pleasurable use on such a day as that on which these lines are penned. Will no one render us aid before we get into the condition so feelingly described by the negro, when he said that "it couldn't be no hotter in our house, for de termometer 'as got bang up to de top, dat's one comfut!"?

Miscellanea.

Some idea of the difficulties in the way of making large telescopes may be had from the fact that there have been nineteen failures to cast the thirty-six inch glass for the large telescope to be mounted in California.

The fire insurance companies of Sweden have offered a reward of 2,000 crowns for the most practical device to arrest sparks and cinders from locomotive and steamboat smoke-stacks. A trial of different devices that may be sent in will take place in Stockholm, Sweden, during the month of August, this year.—*Engineer.*

The effective armoured fleets of the leading naval Powers of Europe might be summarised as follows:—England, 329,520 tons; France, 201,789 tons; Germany, 74,007 tons; Austria, 63,110 tons; Russia, 83,321 tons; Italy, 59,905 tons. This is food for deep reflection. Had the energy expended in producing these munitions of war been devoted to labouring for the mutual welfare, instead of destruction of mankind, how much good might have been wrought?

As a passenger train on the Painsville and Youngstown Railroad was at Youngstown, Ohio, July 1st, and just as it was pulling away from a water tank, a valve in the latter broke, sending an 8-in. stream of water against the train, breaking all the windows and deluging the coaches. Many of the passengers, with their clothing thoroughly water-soaked, leaped from the train, rolling down an embankment, and some were bruised. Several ladies in the train had their dresses ruined.

On the Liverpool and Manchester section of the London and North-Western Railway, some of the trains are now lit by Swan 20-candle-power lamps. A Brotherhood engine on the tender drives the dynamo, and near the driver's hand is a regulator fitted with a lamp showing the candle-power of those in the carriages. Each compartment has duplicate lamps; in the event of accident to one, the other is instantly made incandescent.

The success of creosote as a preventive of the attacks of the toredo worm could not be better exemplified than by the tests made by the Louisville and Nashville Railroad. The company caused timber treated with the creosote process, and perfectly healthy cypress timber, sound in every respect, to be submerged at East Pascagoula. Both kinds of timber were recently raised, and that treated by creosote was found to be in a perfectly healthy state, while the other was found to be honeycombed by the worms. —*Picayune.*

Telephony.—Servia boasts one telephone line one kilomètre long, connecting the Ministry of the Interior and the Préfecture at Belgrade. Bulgaria and Luxembourg do not believe in the telephone; at all events, they have not a yard of line at work at present. Turkey has three lines, one used by the Administration of Telegraphs, the second used at a life-saving station on the Black Sea, and the third belonging to the Eastern Telegraph Company and the Ottoman Bank. The above lines represent a total length of wire of 41 kilomètres.—*Electrician.*

One of Barnum's secular elephants, "Allah," was attacked with enteritis while in Cincinnati. Dr. George W. Bowler, V.S., was called in, and relates his experience in *The Journal of Comparative Medicine.* The diagnosis being made, he prescribed and administered the following liberal dose: lard, eight pounds; linseed oil, one gallon; tincture of opium, one pint; spirits of nitrous ether, one pint; syrup, one quart. The lard and oil were first mixed, then the other ingredients added. The trunk was raised above the head and the mixture poured down the throat through a large metal tube. The animal recovered.—*American Druggist.*

Electric Lighting in Lausanne.—The Swiss Electrical Company have, says the *Electrician*, lighted the Cantonal Hospital at Lausanne on the Edison system. The installation comprises 236 lamps and three dynamos, the latter being driven by three turbines. The company also have a central station in the same town, where there are two dynamos driven by two turbines of 35 horse-power each. These supply current to 280 lamps. There are 72 subscribers to the company's system.

A Red Lunar Halo.—A magnificent lunar halo of a red hue was, says *Engineering*, observed at Rome by M. Tacchini, on July 4, at 9.30 p.m. The moon itself showed of a reddish hue, and was surrounded by a reddish aureole, of a width rather more than the diameter of the moon. The tint was nearly that of bright, pure copper. The moon at the time was nearly 30 degs. high; and the phenomenon was seen till 10 o'clock. On July 5, the same phenomenon was visible, but more feeble; on the 6th, the sky was clouded. Afterwards the phenomenon was no longer seen. During the nights of the 4th, 5th, and 6th the atmosphere was excessively humid, from 9 p.m. to 6 a.m. of the following mornings. The saturation during these intervals was almost complete; whereas, during the day, the humidity fell to 0·40.

As a commercial port, the trade of Antwerp has increased to an astonishing extent within the last few years, as shown by the following figures:—In 1869 the tonnage of the port of Havre was 1,042,236; of Hamburg, 946,154; of Rotterdam, 673,830; of Antwerp, 546,554; of Bremen, 426,237; of Amsterdam, 413,780; of Dunkirk, 279,144. Of all the northern ports, therefore, Antwerp ranked fourth. But in 1882 it had so rapidly increased, owing to the improved harbour works and navigation of the Scheldt, as also to the greatly extended railway communication, that Antwerp has mounted to the top of the tree, and now stands first. The figures of 1882 show that the tonnage of the port was 3,401,534; while that of Hamburg was 3,030,909; of Havre, 2,266,927; of Rotterdam, 2,085,338; of Bremen, 1,129,217; of Dunkirk, 939,343; of Amsterdam, 784,379.

M. Lazare Weller has conducted a series of valuable experiments with the object of ascertaining the relative electric conductivity of metals, submitting the results to the Société Internationale des Electriciens. They are referred to a pure silver wire, 1 millimètre in diameter, and having a resistance of 19·37 ohms per kilomètre at 0 deg. C., as a standard. The following are his figures:—Pure silver, standard 100·00; pure copper, 100·00; silicon bronze (telegraph), 98·00; alloy of equal parts silver and copper, 86·65; pure gold, 78·00; pure aluminium, 54·20; silicon bronze (telephone), 35·00; pure zinc, 29·90; phosphor bronze (telephone), 29·00; alloy of equal parts silver and gold, 16·10; Swedish iron, 16·00; pure Banca tin, 15·45; 10 per cent. aluminium bronze, 12·60; Siemens steel, 12·00; pure platinum, 10·60; pure lead, 8·88; pure nickel, 7·89; antimony, 3·88.

The report of the directors of the Panama Canal Company on the present condition of the works states that the number of men employed in May, 1884, was over 19,000. It is calculated that the excavations amount to 110,000,000 cubic mètres, in addition to 10,000,000 cubic mètres of earthworks in altering the course of the Chagres. Up to the end of April, 1884, the total amount of work done is represented by 5,243,302 cubic mètres of earth removed. Until January 1, 1884, however, the real work of cutting the Canal had scarcely fairly begun, and of the total of 5,243,302 cubic mètres of earth removed, nearly half, that is to say, 2,482,768 cubic mètres, have been removed in the first four months of the present year. In the total of 120,000,000 cubic mètres of ground to be excavated, 40,000,000 will be taken away by means of dredgers. The projector says there can be no doubt of the Canal being open for navigation before the close of 1888.

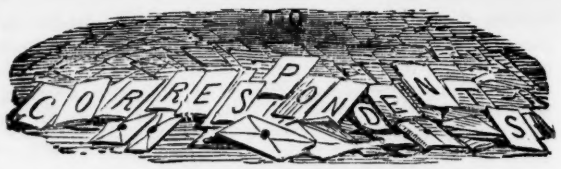
Tramways at Rio de Janeiro.—The Brazilian capital is particularly rich in tramways, there being no less than 133¾ miles within the city and suburbs. The four largest of these tramways are the Botanic Gardens, 22½ miles; the St. Christo, 27½ miles; the Villa Isabel, 17 miles; and the Urbain, 28½ miles. Altogether the 133¾ miles of tramway existing in Rio de Janeiro and the neighbourhood are owned by nine companies. The rolling stock placed by these companies upon the lines comprises 554 carriages, of which 363 are used for the conveyance of passengers, and 191 for the carriage of goods. The traction service is carried on by mules and horses, and there are no less than 4,921 of these animals at work upon the lines. The working staff comprises 1,482 persons. The number of passengers conveyed over the lines has averaged 35,532,926 per annum. The net profits realised upon the four principal lines last year were as follows: Botanic Gardens, £63,024; St. Christo, £62,165; Villa Isabel, £17,516; and Urbain, £43,666. Two of the smaller tramways were worked at a slight loss last year.—*Engineering.*

Pasteur's Experiments on Rabies.—The commission deputed by the French Government to verify the discoveries reported by M. Pasteur in relation to canine madness have so far completed their investigations as to send in an official report. The report, which

appears in the *Journal Officiel*, certifies that M. Pasteur has advanced nothing that has not been found strictly correct. Science, it adds, has solved the problem of rendering the dog proof against the disease, by means of a preventive inoculation of attenuated virus. All the dogs declared by M. Pasteur to be protected by the immunity he had conferred upon them resisted the inoculation with the strongest virus, while the majority of dogs who had not been so protected became rabid when inoculated with the strong virus, and died. The committee propose hereafter to make further experiments as to the duration of immunity after preventive inoculation, and also as to whether protection is afforded if the preventive inoculation does not take place until after a bite has been inflicted by a rabid dog. The committee said that they have prepared this preliminary report in order that M. Pasteur may use it for his communications to the scientific congress at Copenhagen "on results which honour in so high a degree French science, and give it a new title to the gratitude of humanity." The committee consists of MM. Beclard, Paul Bert, Bouley, Tisseraud, Villemin, and Vulpian.

A Marsh under the Ocean.—Every south-east and southerly storm throws upon the south side beach of Long Island large masses of peat, lignitic branches, trunks of trees, fossilised leaves, and animal remains. The coast, it is said, after a heavy wind and surf, is strewn with these apparently unaccountable objects from Atlanticville to Water Island. The geologists state that the appearance of débris seems to be the result of the wave action of the surf upon the remains of a vast swamp, at present submerged beneath the Atlantic. After due calculations they have decided that this submarine swamp extends fifty miles longitudinally and half a mile latitudinally. Professor Newberry, of Columbia College, gives the following explanation of the existence of this marsh:—"The coast is settling, and what had been swamped places on the land have been submerged by the waves. We find along the coast of New Jersey, Staten Island, and Long Island, evidences of subsidence going on at the present time, and that which was forest land and marsh land is now out at sea. In some places the peat beds which were marshes on the land have been submerged, and we find shell-fish bored into the peat. I have plenty specimens to show that the level of the land has changed, and we have also fresh evidence of that circumstance in the fact that stumps of trees of a large size are found along the coast at some distance in the water, where they are only, perhaps, visible at low tide. They must have grown on comparatively dry ground."—*Engineering*.

Small-pox, Chicken-pox, Cow-pox, and Vaccination.—By far the most important medical work for the past quarter is the report on the above-named subjects, by Joseph Jones, M.D., President of the Board of Health of the State of Louisiana. The report consists of 410 closely-printed pages, and, like everything that comes from the pen of this most original, industrious, and truly gifted author, is a model from which every one who reads it may take something for copy and instruction. Reading the essay carefully through, I am brought to the conclusion that no approach to it as a history of vaccination can be found elsewhere, and that we, in England, have nowhere collected in any volume anything like the amount of information that has been here produced by our learned American *confrère*. Every point connected with small-pox, vaccination, and spurious vaccination has been sought out, condensed, analysed; while drawings, very natural in character, are freely interspersed to illustrate, from point to point, the author's histories, views, or conclusions. Amongst the general conclusions which the author draws at the close of his treatise the following are some of the most important:—(*a*) Vaccination, when carefully performed on Jenner's method, is as complete a protection from small-pox now as it was in the early part of the century; (*b*) Without vaccination, the application of steam and navigation and land travel would have, during the past fifty years, scattered small-pox in every part of the habitable globe; (*c*) Vaccination has not impaired the strength and vigour of the human race, but has added vastly to the sum of human life, happiness, and health; (*d*) Inoculation for small pox, which preceded vaccination, induced a comparatively mild and protective disease, but multiplied the foci of contagion, kept small-pox perpetually alive, and increased its fatal ravages among mankind. On one subject only could it be wished that this excellent authority had bestowed more labour—namely, whether the diffusion of small-pox in last century by the process of inoculation did not form the background on which vaccination stands so prominently as a blessing, not altogether unalloyed, to our race. In other words, if there had been no universal distribution of small-pox by inoculation, would the disease under an improved hygiene have died out altogether without vaccination? There is, perhaps, no one living who could answer this one all-important question more completely than our author. Will he undertake the task?—*The Asclepiad*.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

THE SENSE OF TASTE.

[1364]—In the interesting article on "The Sense of Taste," Knowledge, 8th inst., its author makes no reference to instinctive desires or longings, and how these may influence taste. An acid drink or unripe orange may be enjoyed at one time, but much disliked at another; or, again, pickles, uncooked lettuce, raw onions, &c., are sometimes eagerly accepted and enjoyed, while at other times they are rejected as most uninviting. These instinctive cravings are most interesting to watch, as in my experience they often indicate certain wants of the body. Several times I have seen a very young infant object to suck its mother, apparently because the milk was poor and unsatisfying; while it readily took the nursing-bottle, which, moreover, did not always agree with it.

If Mr. Grant Allen could give us an article embracing and explaining these and such like points, it would be most interesting and instructive. Wm. Main.

PERSPECTIVE.

[1365]—I must still maintain that R. Jones is wrong "in his criticism" on perspective.

If, instead of one cube, he had a row of them extending right and left of his point of sight, it would be curious to know whereabouts he would begin his two slopes; for, according to him, only the middle cube is parallel to the spectator.

Now, instead of cubes, let him stand in the middle of his shelf and draw that. The longer the shelf the better, if he only remembers another rule in perspective, viz., not to attempt to "take in" more than you can see without turning the head (or about one-third of your hemisphere).

Lest his preconceived notion should interfere with his drawing the line correctly, let him test its position by holding up a ruler, so as to tally with the edge of the shelf.

Or, instead of "an imaginary plate of glass," let him spread a thin layer of gum on one of his window-panes, and, standing directly in front of it, let him (when the gum has dried) trace on it with pen and ink (shutting one eye), both to right and left, say, the area-rail of the opposite houses, if in a street. He will, doubtless, thus become a convert to the received system, as he cannot deny that the result is "as it appears to his eye."

Rosalie Vansittart.

[1366]—The horizon line of the sea, as viewed from an elevated point, is evidently a hyperbola. At St. Helena, at the back of the Artillery Barracks (which are on the top of a cliff 600 ft. high), is a long wall with a level top. Standing on the hillside behind it, at such a height that the wall-top and horizon about coincide, the latter may be seen to rise in a distinct arch above the former, the ends of the arch cutting the wall at a very acute angle.

Aug. 4, 1884. Musafir.

WEARING THE DEAD.

[1367]—In your article on "Embalmers," mention is made of a Guinea tribe who "reduce their relatives to a liquid state and drink them down." It may interest your readers to hear of a tribe who *wear* the remains of their dead.

When in the Yosemite Valley, N. California, in October, 1870, I met a small band of that very low type of the human race, the Digger Indians. They had come down into the valley from Mono

Lake to collect acorns for their winter supply of food. In stature they are short, and almost ape-like in expression. Like all Indian tribes, the hair is worn long, but in this case growing low on the forehead, nearly to the eyebrows.

I noticed, however, that one of the band had his locks cut short, and the head smeared all over with a tarry mess. On naming this to the Indian agent whom I afterwards met, he informed me that what I had seen was the "Digger's" sign of mourning. When one of the tribe dies, the body is burnt, the ashes are collected by his nearest relative, who cuts his hair short, mixes the ashes with a resinous gum from a pine-tree, and smears his head with the mixture, which is allowed to remain on till spontaneously removed. This statement was afterwards confirmed by Mr. Hutchins, the first resident in the valley. T. R. Clapham.

Austwick Hall, Aug. 9.

A WORM I' THE BUD—WHAT'S IN A NAME?

[1368]—With reference to Mr. Clodd's paper on tooth-ache depending on the presence of a worm, I may say it is a popular belief in this and neighbouring counties.

Tooth-ache is cured by pouring hot-water on henbane seeds contained in a jug. The seeds germinate at once in the boiling water; the plumule looking, to a casual observer, just like a worm. It seems strange to me boiling water should have this effect on seeds, especially the bought henbane seeds of a druggist's shop, which I have sown many times, but could never get to come up; I presume on account of their having been dried with the aid of heat.

Is the following a coincidence? Fourteen years since the minister of George-street Congregational Chapel was a Mr. Parkinson; on his leaving a Mr. Parkyn succeeded him; Mr. Parkyn then left and was succeeded by a Mr. Park. Since then I believe they have been without a regular minister. Eligible candidates having appropriate names might apply. Thomas Ladwick.

Red Hill, Surrey, Aug. 14th, 1884.

A COINCIDENCE.

[1369]—The following curious coincidence may, perhaps, just escape the editorial waste-basket so well-known to readers of Knowledge. The death of the late Duke of Wellington was announced in the evening papers on August 13. Our family had been engaged in preparations for removal to a new residence for two or three days previously, and some packing-cases sent from the contractor had been lying awaiting use during that time. On the evening above-mentioned these were opened, and there was found, amongst some straw, an old newspaper of the year 1852, in which, singular to say, we came upon a report of the funeral ceremony of the former Duke,—the illustrious hero of Waterloo. G. H. H.

PROPOSED MEMORIAL TO SIR WILLIAM HERSCHEL IN THE OCTAGON CHAPEL, BATH.

[1370]—[We willingly reproduce the subjoined letter, which appeared in the *Bath Chronicle* of August 7. Communications may be addressed to Rev. Wm. Anderson, 48, Pulteney-street, Bath.]

Sir,—Among the persons whose lives and labours have ennobled the city of Bath, none stand so high in force of character, in difficulties overcome, and in magnificent services rendered to science as William Herschel and his scarcely less distinguished sister and fellow labourer Caroline. Herschel was great as a thinker, a worker, a philosopher, and, above all, a discoverer. Inferior to Newton as a philosopher, he was greater as an astronomer. Arago was astonished by "his extraordinary success as a discoverer." Judged by the difficulties which he overcame, as well as by the actual additions which he made to human knowledge, by the instruments which he invented and bequeathed to future discoverers, and by his prescient anticipations of the future triumphs of science, he was by far the most distinguished citizen who ever lived in Bath. During the sixteen most fruitful years of his life—from 1766 to 1782, *i.e.*, from his 28th to his 42nd year—he resided in Bath, as organist of the Octagon Chapel and director of the public concerts. He frequently composed anthems, chants, and whole services for the choir under his management. Music was the business, astronomy was the amusement of his life. Before he made the discoveries which have given him an immortal name, he had to bring to completion, by a series of labours of almost incredible industry and perseverance, sometimes extending to sixteen hours of continuous work, the instruments of discovery. He erected a furnace in his garden, where he and his brother worked for months of almost incessant toil, and made hundreds of specula before he completed the great reflector through which he discovered the planet Uranus, on the 13th of March, 1781. His illustrious sister read to him while turning the lathe or polishing the mirrors. Subsequently, after he had been invited to Windsor, he said, "I would rather be polishing a speculum than at Court." Then he found that the telescope which he and his sister had constructed was superior to anything in the Royal Observatory. He discovered the motion of the solar system in space. He mapped out all the double stars he met with. He first discovered the lunar volcanoes.* He constructed a telescope of 40 ft. focal length and 8 ft. aperture. In the words of his biographer, in the last number of the *Encyclopædia Britannica*, "He demonstrated the action of the same mechanical laws among the distant members of the starry firmament which bind together the harmonious motions of our solar system. This sublime discovery would of itself suffice to immortalize his memory in the respectful homage of all future races of intelligent men." In him there were combined—each in its highest form—the attributes of the artisan, the artist, and the astronomer in a degree so high and employed for purposes so noble, that few cities can point to a citizen so noble and so worthy of lasting remembrance. I have been requested by the committee of the Octagon Chapel, in which the organ associated with the name of Herschel still remains, to write this letter, in the hope that their efforts to put up in the chapel a memorial window not unworthy of its distinguished organist may be aided by those of our fellow-citizens who desire to honour an illustrious name and transmit a memorable example. William Anderson.

LETTERS RECEIVED AND SHORT ANSWERS.

T. R. Clapham. Does your sketch of a flash of lightning represent the appearance it represented to the naked eye, its track through the ground, or what?—Galvaniser. No.—T. McIlvenie. Probably the situation of assistant in the Science and Art Department, or in the British Museum, would be one as congenial to your tastes as any; but either would involve a pretty severe competitive examination. There is no profession or occupation outside of such subordinate Government appointments as these, in which you can begin to earn anything for many a long day.—Quidam. Your mistake lay in writing a second time for an explanation. Such articles are merely used as "padding" in a daily newspaper, and may lie unused for an indefinite time. I have seen one of my own appear after a lapse of twelve months! An editor (like the Captain of one of her Majesty's ships) must, *ex necessitate*, be an autocrat; and, according to the usages of journalism, you have nothing whatever legitimately to complain of. —James Gillespie. Will you be good enough to read my replies to you on pp. 40 and 79. I neither will nor can answer correspondents privately through the post.—M. asks how distemper painting is practised, the colours required, where they are to be obtained, and the ground used for painting on. He further wishes to know whether the process might not be employed in painting landscapes from nature, it being alleged that J. M. W. Turner so used it. Pending any detailed reply with which he may be favoured by some brother reader, he may get some hints from Godwin's "Art of Mural Decoration," published for a shilling by Winsor & Newton. —Con Spirito. There cannot be the slightest doubt that when a table moves in a *bonâ-fide* experiment such as you refer to, it does so through the unconscious muscular action of the operators. At the time when table-turning became a fashionable craze, our great departed Physicist Faraday devised a simple piece of apparatus, by the aid of which any pushing action on the part of the experimenters was at once rendered visible by the motion of the long arm of a lever. When the top and bottom parts of this simple contrivance were rigidly connected (so that the arm was a fixture) and the hands of the persons sitting about the table were placed upon it, the table went round merrily. The moment, though, that such connection was broken, so that a push on the top plate of the apparatus caused the arm to move, the performers had ocular demonstration, by its swinging round, that they were (wholly unconsciously) themselves pushing; and, their attention being thus directed to it, ceased to do so; the inevitable result being that the table stood stock-still. Thanks for your friendly expressions.—C. J. Pettit. I can find nothing about a tricycle (American or otherwise) in Knowledge for August 8. See concluding paragraph, in capital letters, at the head of Correspondence Column.—C. E. Parker-Rhodes. Received too late. Thanks.—H. Romeike. I am much obliged; but the needs of a scientific journal scarcely include such paragraphs.

Errata.—In column one, p. 130, line 14 from the bottom, the words "at S', 4 feet from it," should immediately precede "and so on."—In line 17, col. one, p. 145, "for what" should be "for which;" and in line 40 of the same column the word "where" should follow "Cassiopeia."

[* This is erroneous; but in no sense affects the appeal.—Ed.]

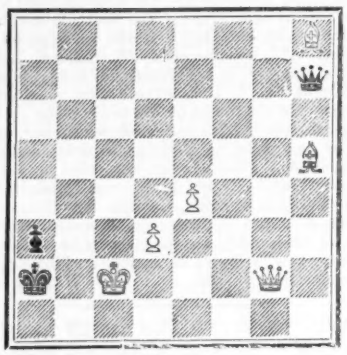
Our Chess Column.

By Mephisto.

PROBLEMS BY I. G.

No. 124.

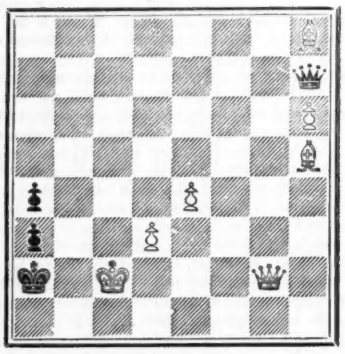
Black.



White.

White to play and mate in three moves.

Black.



White.

White to play and mate in three moves.

1. Kt to KB3. This first move leads to a close opening, producing a very safe game for White. The opening is remarkable for an entire absence of combination leading to any direct line of play. The player is soon thrown upon his own resources, and he has to struggle for position. This kind of game is specially adapted for match play between strong players, as it requires first class judgment and experience to conduct these subtle wrangles for position in which minute advantages are gained, which, if properly followed up, lead to a winning advantage for the End game. Weaker players not having sufficient judgment, miss the subtle points in this opening, which then becomes dull and featureless, but always affording a comparatively safe game to the first player.

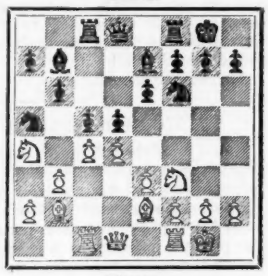
The opening affords but very poor practice for young players, who ought to adopt lively and attacking debuts, as by undertaking such attacks and defences they will gradually gain experience and a deeper insight into the game, they will also derive much pleasure from such practice, which after all is the main object of Chess play.

The effect of 1. Kt to KB3 is twofold—to prevent P to K4, also to enable the first player to avoid the French defence. If Black plays 1. P to Q3 with the object of playing 2. P to K4, White will gain an advantage by playing 2. P to Q4, or he may play 2. P to K4; and if 2. P to K4, White may reply as in the Philidor defence by 3. P to Q4 with advantage.

If in reply to 1. Kt to KB3, P to QB4, the same as in the Sicilian defence, White can at once play 2. P to Q4, and the QP will be weak, 2. P × P. 3. Kt × P, P to K4. 4. Kt to Kt5, &c. 1. P to QB3 may be played, but the best replies are 1. P to K3 and 1. P to Q4. It is not desirable to play 1. Kt to QB3 as it is requisite to play P to QB4 later on, to counteract the advance of White's centre Pawns. Having stated sufficiently to indicate the import of 1. Kt to KB3, we will proceed to the normal variation arising out of that move:—1. Kt to KB3, P to K3. 2. P to Q4, P to Q4. 3. P to K3, Kt to KB3. 4. P to QKt3, B to K2. 5. B to Kt2, Castles. 6. B to K2, P to QKt3. 7. P to QB4, B to Kt2. 8. Castles, P to QB4. 9. Kt to B3, Kt to B3. 10. R to B sq., R to B sq. 11. Kt to R4, Kt to R4.

In this opening, the player who is too soon compelled to change Pawns, is at a disadvantage, as the opponent, by retaking with Pawn, obtains a commanding position. If 12. P × BP, P × QP. 13. B × Kt, P × B. 14. P × P, P × P. 15. Kt to R4, threatening B to Kt4, B to B5, and Q to R5, &c. If in reply to 12. P × BP, B × P. 13. P × P, B × P. 14. Kt × B, isolating and weakening the BP. If Black, on his 11th move, instead of Kt to R4 plays Kt to K5, then 12. Kt to Q2 still threatening to win the BP by P × KP. We must now come to consider the various deviations from this line of play by which Black seeks to avoid this knotty position.

Black.

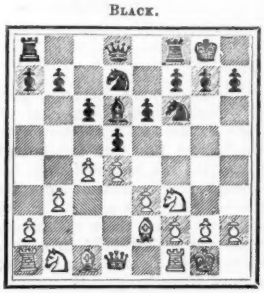


White.

For that purpose we quote Blackburne's method of posting the P on QB3, playing the Kt to Q2 and B to Q3, viz., 1. Kt to KB3, P to Q4. 2. P to Q4, P to K3. 3. P to K3, Kt to KB3. 4. B to Q2, Kt to Q2. 5. P to QKt3, B to Q3. 6. P to B4, P to B3. 7. Castles, Castles.

In this position, which of course may be arrived at by various transposition of moves, Black is somewhat confined. His intention is to play B to Kt sq., but we doubt whether any attack need be feared on the K's side, as P to KKt3 is always available. White, when opposed to strong play, not wishing to incur any risk, may play B to R3, compelling the exchange of Bishops. White may also play B to Kt2 or Kt to QB3. The latter move may lead to complications unfavourable for White, for if Kt to K5, Kt × Kt, P × Kt, Kt to Q2, P to B4, White cannot play P to B3 now, on account of Q to R5. It seems that when Black does not play P to QB4 but P to B3, then the White B is better placed on Q3.

Black.



White.

White may arrive at the same position by playing as his first move either 1. Kt to KB3, P to Q4. P to QB4, P to K3, &c.; while he may vary his moves considerably, Black has to be careful to answer correctly.

We think we have given the leading principle of this opening. Endeavour to develop all the pieces and to support the QP and QBP until the position is ripe for an advance on the Q's side. White must meet deviations in a careful manner, guarding against exposing his game or attacking prematurely, and he will always obtain a fairly developed and safe game.

SOLUTION.

Problem No. 122, p. 124.

1. R to B4	B × R, or		B × B
2. K to Kt5	Any	2. Q to Kt4	K to K4
3. Q to KR sq.	Mate	3. Q × P	Mate

If B to B3. 2. B × B and mate next move.
If K to B5. 2. Q × P and mate next move.
"Well constructed and somewhat difficult."

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Correct solutions received.—Problem No. 122, Geo. Thompson, W., A. W. Overton, J. K. Milne. No. 123, John Watson, Geo. Thompson, C. T. G.